AUG 19 1927

Telephone Engineer

VOL. 31, No. 8 CHICAGO

STROWGER AUTOMATIC

Making Strowger Automatic Equipment Weatherproof

WHEN Strowger Automatic equipment is shipped to such rugged climates as Manchuria or Canada, or to warm, moist places, such as Hawaii and the Philippines, it is with the certain knowledge that its operation after installation will be just as reliable as it is in the country of its origin.

The ability of Strowger equipment to function correctly even under the most adverse climatic conditions is determined long in advance of installation, both by actual experience and by the most thorough tests that science can devise.

The testing laboratories of Automatic Electric Inc. are equipped with facilities for duplicating various atmospheric conditions, to determine the effects of heat, cold, humidity and dryness on the operating characteristics of the various elements of the complete exchange. These tests insure reliability and durability for Strowger Automatic operation the world over.

Automatic Electric Inc.

Factory and General Offices: 1033 West Van Buren St.
Chicago, U. S. A.

TELEPHONE EQUIPMENT

AUGUST, 1927

A LEANING pole and an eight-foot ditch beside it. Looks like a tough job. But one man, with this Simplex Jack and its eight-foot pipe, can straighten up that pole in no time.

"One man"—there's the great advantage of this powerful little 5-ton Jack. With the 325 Simplex Jack one man, by himself, can pull or straighten all your light poles.

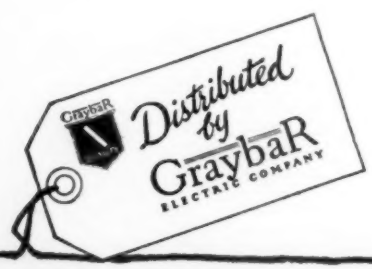
Try out a 5-ton Simplex Jack on your light pole work, and convince yourself that the economy of its operation will more than pay for the Jack.

Simplex Jacks

Made by

Templeton, Kenly & Co., Ltd.

CHICAGO, ILL.



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Telephone Engineer

Volume 31 AUGUST, 1927 Number 8

"Follow Through" Not Easy for New Owners

Recently a certain telephone plant received what a neighboring telephone man describing as a "darned good selling." Since some of the figures involved were typical of other transactions we were interested in making an analysis of the proposition. While the figures given below are not exact they are sufficiently so to illustrate the situation without distorting the facts.

The plant numbered 700 stations in a community of 3000. The reported selling price was $100,000 and this is probably the true figure. Apparently the purchaser expects to go ahead with the operation of the plant.

According to its annual reports, the gross income of this company was $20,000 annually and the expense $16,500, including all charges except interest and dividends. Depreciation was set aside at the rate of $2350 annually and included in the expenses.

If the present income and expenses were maintained the net revenue would amount to $3500 or 3½ percent on the selling price which is obviously inadequate. Certainly something must be done immediately if the purchaser is to realize anything but a loss on his capital.

Assuming that a 7 percent return is necessary, at least $3500 must be added to the net revenue. Furthermore, depreciation charges on a plant valued at $100,000 would be at least $5000, making $2650 additional for this item. In other words, allowing for no increase in operating expenses, $6150 additional revenue must be secured.

Taking another basis of figuring, the average for 17 plants of its class in the same state showed that 19.5 percent of gross revenue was available for interest and dividends. Using the same $7000 return required, a gross revenue of $27,900 would be required to produce average results.

Apparently a gross revenue of approximately $27,000 annually will be required to carry the property on the new basis. Since this revenue can only be obtained by an increase in subscriber rates it would seem that the public in the community served is facing an increase of 50 percent in its telephone bill if the plant is to succeed.

The old owner has received proper compensation for his effort of many years in building up the property and the public with the increased rates will be paying no more than the service is worth. We hope that the new owner will succeed, but we are unable to see where he will be able to realize a profit that will in any way compensate him for the work and worry incidental to placing the property on an earning basis on the amount paid for it. He has a job which we would not be keen about undertaking.

The Burden of Self-Made Misery

Almost everyone numbers among his acquaintances some individual who is convinced that the hand of the world is against him; that the purpose of all the other people on earth is to take advantage of him and that life is a continual fight to obtain his "rights." Such a person is inevitably boresome in his complaints against the unfair treatment which is meted out to him.

The telephone business is not without its quota of this type and we all know some of them. They are not alone among the employees but among the managerial element as well. If we were to believe the stories some of them tell us, the workers in the telephone field are a disgruntled, shiftless and dishonest lot whose only ambition is to do as little work as possible for as much pay as they can force the management to give; the public is an aggregation of heartless skinflints with no other purpose than harass the poor telephone company with repeated complaints of service while they are unwilling to pay rates that will more than keep the company out of the hands of the bankruptcy court; that regulatory bodies are made up of bands of self-seeking politicians in whose dictionaries the words justice and right have been erased and whose sole endeavor is to play to the ignorant masses in order that they may perpetuate themselves in office.

It is strange that this type of individual never seems to realize that the difficulty may be internal rather than external; that instead of the times being out of joint he, himself, may be out of joint with the times. He does not realize that the vast majority of telephone employees are loyal, contented workers who recognize that their own best interests and the best interests of their companies are identical; that the majority of the public is willing to pay an adequate rate for service if it is convinced that the company is trying to do its part by giving the best possible service and that regulatory bodies have in the main treated utilities fairly and justly and that the present stability of the utility business is largely the result of intelligent regulation.

How much better is the philosophy of one of our friends who says that he prefers to think that all men are honest and fair and that he much prefers to suffer a loss occasionally due to the fact that some are not, rather than to darken his days with the suspicion that everyone is going about with the intent to defraud him.

Government "Tight," Policy Doesn't Work

The criticisms of the attitude of the British Government toward the telephone system as reported by a London correspondent in another umn, bring out some features of government ownership and operation of utilities that have not been given much consideration in this country. It is true, that there is on this side of the Atlantic little general sentiment favorable toward government ownership but in certain quarters no opportunity is lost to make comparison between the supposedly philanthropic administration of utilities in foreign countries as compared with what is designated as the practice of "heartless monopolies" in America.

From the criticisms, it would seem that the British Government in a wave of economy has failed to make the necessary appropriations for extension of the telephone system in spite of the fact that the system each year returns its profit to the general treasury. As a result the system is not keeping up with the demands caused by a revival of the trade and the activities of the Telephone Development Association.

It is easy to understand how a similar condition might be established in this country, in the event of government ownership during a period of government economy such as the policy at Washington during the present administration. Would an administration pledged to strict economy permit the appropriation of a third of a billion dollars for development of the telephone system as is being done by private interests in 1927? Write your own answer.

Good Ground Man Is Often Overlooked

As we were driving along a country road, a few days ago we came upon a line gang at work. It was only a small gang, three men, but they had a well equipped Ford truck and were going ahead with the work at a rate that might hurry some larger gangs to follow. The particular job at the time was placing guys and we took some time to watch the proceedings to see how things were done.

It did not take much observation to show that the key man of the gang on that work was not the foreman nor the lineman but was the ground man. It is true that the other men did their work with ease and efficiency but much was contributed to the effectiveness of their work by the manner in which they were served by the ground man.

From the time the truck stopped at a pole till the time it was ready to start to the next location, there did not seem to be a moment's delay. Every piece of material and every tool was in place and ready for use by the time they were needed by the lineman and the foreman who did the work on the anchor end of the guy. By the time the ends of the strand were bound, every tool was back on the truck, the block lines were coiled and arranged for most convenient use at the next place and nothing was left but to climb on the truck and start.

Comparing the results achieved by this gang with others we have seen, led us to the certain conclusion that the importance of having a well trained ground man in a line gang has not always been appreciated. Too frequently the policy is to hire casual help for the ground work rather than to find a man who is content to do the humble job of "grunting," train him for the work and then give him more or less continuous employment.

Construction Work Gives You Publicity Opening

During the summer season when construction work is at full swing, telephone companies have some of their best opportunities of the year for obtaining desirable publicity through news columns of local papers. Almost every item of the work has an element of legitimate news value in it and local editors are always anxious to get good readable items of local interest. Try writing up a story of what you are doing and see the look of interest and appreciation on the face of the editor when you give it to him.

CONVENTIONS

United States Independent Telephone Association
CHICAGO, OCTOBER 18-21

Indiana Independent Telephone Association
HOTEL CLAYPOOL, INDIANAPOLIS
SEPTEMBER, 20-22

Experts Survey Recent Telephone Progress

A particularly good summary of technical advances in communication art is contained in the annual report of the Committee on Communication in the American Institute of Electrical Engineers, published in the Journal of that body. H. P. Charlesworth, Plant Engineer of the Bell system, was chairman of the committee during the past year. The following paragraphs are of particular interest to telephone men:

Dial Telephony

The rapid application of dial telephone systems has continued. During the year about 500,000 dial telephone stations were installed, bringing the total in service in this country, as of the first of January, 1927, to approximately 2,400,000.

A means has been developed for remotely operating small magneto telephone plants where this is desirable. The name applied to this means is the semi-automatic magneto exchange. In a system of this type the subscribers' stations are equipped with magneto telephones. Connections are switched remotely by means of automatic telephone apparatus under the control of an operator, who employs a dial trunk from a control center into the exchange area. Any number of such exchanges may be controlled from the operating center.

Toll Telephone Service

Further progress has been made in the development and application of methods for increasing the speed of toll telephone service. The plan, the so-called A-B method, of handling the large volume of messages between nearby points in a manner quite similar to that used in handling local traffic, has been considerably extended. The improvement of service has progressed to a point where even at the longer hauls it is now possible in many cases to complete a toll call while the calling subscriber remains at the telephone. An important factor in this improvement is the development of a method of operation combining the work of the line and recording operators so that if the number of the called telephone is given the recording operator, she can proceed at once with the handling of the call.

A new type of toll switchboard has been made available for toll centers having sufficient traffic to require separate toll and local switchboards. The signaling equipment which was previously located in the cord circuits has been transferred to the line and trunk circuits and use has been made to a considerable extent of common positional equipment.

Telephone Toll Cables

The year witnessed the opening on December 15, 1926, of a new long distance cable link between Chicago and St. Louis, insuring for the future the best possible storm protection for communication through from New York to St. Louis as well as between intermediate points. This cable forms a part of the network of cables connecting Chicago, Detroit, Toledo, Cleveland, Pittsburgh, and other cities with the cities on the Atlantic seaboard, and contains circuits for both very long-haul and short-haul telephone business.

The longest circuits of the network are about 1,500 miles in length, but even this does not represent the maximum distance over which circuits of this type can be operated. Telephone repeaters on these circuits are spaced at intervals of approximately 50 miles. Echo suppressors are used to permit operating with volume efficiencies comparable with other long distance telephone circuits. Automatic regulators are employed to compensate for the effect of temperature in changing the attenuation of the cable conductors by suitable changes in the amplification of repeaters in the circuit. The new link is 344 miles in length. It provides more than 250 telephone circuits, and over 500 telegraph messages can also be sent simultaneously, making it the equivalent of 10 heavy pole lines of open wire.

The increasing development of toll cable networks is of extreme importance in the protection of telephone service from interruptions due to sleet storms. During the year 1926, about 2,000 miles of such cables were put in service in various parts of the country, adding more than 400,000 miles to the telephone circuits of the nation.

Carrier-Current Systems

An interesting example of the rapidity with which new developments are finding their way into practical use is to be found in the extensive application of carrier-current telephony and telegraphy to the long distance open wire telephone circuits of the country. There are now on the order of 100,000 miles of long distance telephone facilities provided by carrier methods and some 250,000 miles of telegraph facilities so provided.

The recent growth in carrier-current circuits results from the progress which has been made in perfecting the performance of the apparatus itself and in the development and standardization of methods for co-ordinating a large number of carrier systems upon the wires of a pole line.

During 1926, an interesting application of carrier telephony was made on one of the two Catalina Island telephone cables. Because of the relatively short length of these cables and of their transmission stability, it has been possible to obtain in this way as many as six additional two-way circuits, making a total of seven telephone channels and one telegraph channel on a single-conductor cable. The apparatus employed in this system is similar to that used on open wire lines. By an arrangement of this character, the loss of one of the cables would temporarily reduce the number of telephone circuits only from eight to seven. This system was described in a paper by H. W. Hitchcock which was presented at the Pacific Coast Convention in September.

The use of carrier-current telephony for communication on power transmission lines has increased appreciably. The power circuits involved vary from those of 22 kv. to 220 kv. and the distances communicated over vary from a few miles to those in the order of 300 miles.

The coupling to the transmission lines which in the earlier stages of the art was effected in some cases by means of parallel wires is now being accomplished very largely by coupling condensers or capacitors which are now available in several types for voltages up to and including 220 kv. Considerable progress has been made in the development of by-pass apparatus, repeater stations, portable equipment and various other supplementary pieces of apparatus.

With the increased application of this form of communication, the demand is rapidly increasing for multiple communication channels, particularly in connection with the more extensive individual power systems where load dispatching is divided into districts and in the case of the rapidly growing number of transmission line inter-connections between the large power systems.

Transcontinental Telephony

An important event during the year was the completion of a new transcontinental telephone and telegraph route. The new route connects Chicago with Seattle by way of Minneapolis, Bismarck, Billings, Helena and Spokane. The through circuits comprise at the present time three telephone circuits and 14 superposed telegraph channels. The re-

peaters in use on these circuits represent the very latest development in this field.

There are now three transcontinental telephone routes in service, the others being routed, one through Omaha, Denver, Salt Lake City, and Sacramento, and one via St. Louis, Dallas, El Paso, Phoenix, and Los Angeles. A discussion of some of the more interesting transmission problems and other considerations which are important factors in determining the design of these facilities was presented at the Pacific Coast Convention at Salt Lake City last September in a paper by Messrs. H. H. Nance and O. B. Jacobs entitled "Transmission Features of Transcontinental Telephony."

Loading of Telephone Circuits

An outstanding development in loading coil design which has been put into commercial use in the past year is the use of permalloy in compressed powdered form in the cores of some types of these coils. The application of this desirable magnetic material has resulted in material reductions in both the size and cost of loading coils. The lower cost of loading resulting from this and the other improvements in loading coils referred to in last year's report is, together with the large installations of toll cable in this country, bringing about a very large increase in the use of loading coils.

Electrical Amplification

In the development and application of amplifiers, there is sometimes occasion for amplifying extremely weak signals. Considerable interest attaches to the question of what limitation, if any, is imposed on the strength of the signals that can be amplified. Recent researches have shown that the limit of amplification may be set not by noises coming from the vacuum tubes or the batteries supplying them, but instead from the internal characteristics of the electrical conductors comprising the circuit whose minute currents are to be amplified. In any electrical conductor, minute electromotive forces are continuously produced by the thermal agitation of the electrons and atoms. This is true whether or not external electromotive forces are connected to the conductor. When an electrical conductor is connected to the input of a carefully built amplifier of sufficiently high amplification, readily audible sound may be heard in a telephone receiver connected to the output of the amplifier. The fact that the noise does not come from the amplifier can readily be proved by cooling the conductor by means of liquid air, when the noise heard in the receiver immediately diminishes in intensity, the reduction in noise being due to the reduced thermal agitation in the conductor. The laws underlying this phenomenon were determined experimentally by J. B. Johnson and presented in a paper at the December, 1926, meeting of the American Physical Society at Philadelphia. These laws were later deduced from thermodynamical considerations and presented by H. Nyquist at the February, 1927, meeting of the American Physical Society at New York.

Characteristics of Speech

The continued researches in the characteristics of speech and hearing and the nature of vocal and musical transmission have continued to give results of great importance for the improvement of telephone service, and have also led to many noteworthy developments in allied fields. A very important development based on these researches is the combination of improved phonographic recording devices and high quality reproduction synchronized with motion pictures.

A paper by C. F. Sacia and C. J. Beck entitled "The Power of Fundamental Speech Sounds" published in "The Bell System Technical Journal" of July, 1926, describes the continuing work in the study of speech power by means of the oscillograph. Sounds are considered individually on the basis of instantaneous and mean power. In earlier analyses, the principal emphasis was placed upon the power in speech as a whole.

Radio Telegraphy

Long distance radio telegraph communication is rapidly changing from long waves or low frequencies generated by alternators or Poulsen arcs to short waves or high frequencies generated by thermionic tubes. Within the last 18 months, transmitters up to 40-kw. capacity operating on frequencies of 10,000 to 20,000 kc., 30 to 15 meters, have been produced and put into service. These are replacing arc generators up to 500-kw. and alternators of 200-kw. capacity. Reliable continuous daylight communication has been obtained by using wave lengths around 15 meters, notably between New York and Buenos Aires. During hours of darkness, wave lengths from 25 to 75 meters have been in use in both transatlantic and transpacific services. The greater reliability of the short waves is the result of almost complete immunity to summer static, and the new system is much more economical because of the low power consumption compared to that used for long wave transmission.

The scope of international radio service was further extended during the year by the opening of direct radio circuits for duplex operation between the United States and Brazil.

An analytical study entitled "Behavior of Radio Receiving Systems to Signals and to Interference," made by Professor L. J. Peters, was reported by him at a Regional Meeting of the Institute at Madison, Wisconsin, in May, 1926. This paper discusses methods for studying transient effects of current in radio systems, the degree to which interference can be mitigated by frequency selection methods and the factors determining the interference caused by transmitting stations of various types and by static.

Transatlantic Radio Telephony

An event of outstanding importance in the progress of international electrical communications occurred early in the present year with the opening of transatlantic telephone service between the United States and England. This first telephonic bond between America and Europe was opened to the public on January 7, 1927, following an exchange of brief greetings between W. S. Gifford, President of the American Telephone and Telegraph Company, and Sir Evelyn Murray, Secretary of the General Post Office of Great Britain.

Although the service was at first limited to the metropolitan areas of New York and London, during the months following, service was extended successively to greater areas until it has included most of the British Isles on the European end of the United States and Cuba on the American end. No attempt has been made to give 24-hour service, but service has been available daily for the period which includes the overlapping portions of the business day at the ends, and is being extended.

The principal features of the system added since the description given in last year's report of this committee are that arrangements were perfected whereby both the east-bound channel and the west-bound channel are transmitted in the same frequency band. Thus, the entire two-way system occupied only 3 kc. (58.5 to 61.5 kc.). One thing which contributed materially to this accomplishment is the employment at both terminals of voice-current operated switching devices which function to cut the transmission path to and fro from west-bound to east-bound automatically in accordance with the flow of conversation between the two speakers.

Radio Broadcasting

The results of investigations carried out during the last few years in ascertaining the service area for which broadcast transmitting stations are effective were summarized in a paper entitled "Radiobroadcast Coverage of City Areas" presented at the New York Regional Meeting last November by Lloyd Espenschied and printed in the January issue of the Journal. This is a subject that is receiving considerable attention. These investigations raise questions regarding the desirable power levels to be used for radio broadcasting.

Electrical Transmission of Pictures

During the year the scope of the commercial telephotograph service which has been given for two years between New York, Chicago and San Francisco, was materially enlarged by the extension of the network to Boston, Cleveland, St.

Louis, Los Angeles and Atlanta. Several important developments have taken place during the year, notably the arrangement of the circuits for two-way operation, the installation of phase-correctors on the New York-Boston and Chicago-St. Louis telephone cables to make these circuits suitable for picture transmission, and the fitting of the southern transcontinental route to make it available for service to Los Angeles and San Francisco.

Television

On April 7, 1927, a successful demonstration was given of electrical television by wire circuit between Washington, D. C., and New York, and by radio from an experimental station at Whippany, N. J., to New York.

Television employs many of the principles and some of the apparatus of telephony. The object of television is to reproduce a scene with action, and to do this a series of essentially instantaneous views must be transmitted and reproduced at a rate, 15 or more per second, such that an observer will detect no discontinuity of action. In its present form, the sending apparatus is adapted to obtaining for one participant in a telephone conversation a continuous view of the face of the other participant. The receiving apparatus recreates this view on a picture plane about two by two and one-half inches; or, with an alternative form of apparatus, on a plane about two feet square for observation by more than a single person. At the sending end a narrow beam of light, or rather a rapid succession of beams scan the subject to be transmitted, eliminating at one time an area about a quarter of an inch square and sweeping over the entire scene in less than one-fifteenth of a second. This scanning process is repeated continuously. A group of large photoelectric cells responds to each change in the reflected light. At the receiving station, a glass tube filled with rarefied neon gas and provided with electrodes responds with a brilliancy corresponding to the current received from the photoelectric cell. The high potential requisite to the operation of the neon tube is obtained by the use of vacuum tube amplifiers in the connecting circuit. All parts of the neon tube have the same brilliancy at any instant but the observer views only a small portion at a time, which is uncovered by the synchronizing apparatus provided to insure that the light shall appear to the observer at each instant in the same position on a picture plane as that occupied by the beam-illuminated spot of the distant scene.

In the production of the larger image, a very long neon tube is folded back and forth to form a grid. This tube is provided with 2,500 electrodes along its length. Each electrode corresponds to a single elemental area of the picture plane which is scanned by the light beam of the transmitting apparatus. As the current corresponding to each area reaches the receiving station, it is distributed through contacts to the appropriate electrode and so causes the flash of light similar in location and intensity. The speed of operation causes the observer to see not a series of flashes but a picture as a whole.

New Rectifiers

A new type of rectifier suitable, among other uses, for charging batteries used in communication circuits was described in a paper by L. O. Grondahl and P. H. Geiger presented at the Winter Convention. The rectifier consists of partially oxidized disks of copper. The rectification appears to take place at the junction between the copper and the oxide without observable physical or chemical change, and is similar in character to rectification by the hot cathode type of rectifiers.

Manufacture of Copper Wire

The developments of the past few years have led to great improvements in the methods of drawing copper wire, particularly in the speed of the process. Some of the outstanding features in these developments, together with a description of a copper rod and wire mill designed to meet the new requirements and a brief survey of the copper rolling and wire drawing art, are included in the paper entitled "Developments of the Manufacture of Copper Wire," by J. R. Shea and Samuel McMullan, which was presented at the Winter Convention of the Institute.

Wood Preservation

During the past year, a large amount of research work has been continued in improvements in methods of preserving wood poles, crossarms and other timber. As a result of studies which have been made by the Western Union Telegraph Company, they are placing in service a treatment by which a solution of zinc and arsenic is forced into the poles. Their investigations indicate that on exposure of the treated wood to the atmosphere, chemical changes take place which deposit in the wood zinc arsenite, a toxic material which is practically insoluble and permanent, and that this will constitute a very effective method of preservation against decay.

Bancker Made Western Electric Vice-President

New York City—At a meeting of the directors of the Western Electric Company held July 11, James W. Bancker was elected a director and vice-president in charge of purchasing and traffic, succeeding Jay B. Odell, whose death occurred on July 8. Mr. Bancker has been connected with the company for thirty-five years, having entered its employ as an office boy at the age of fifteen. His most recent post has been that of comptroller of manufacture, to which he was appointed in 1926.

Mr. Bancker was born in London, England, although his parents were natives of New York State. He was brought to this country at the age of five and in 1892, at fifteen, he went to work in the Western Electric's New York shops on Thames street. From that time until 1908 he filled positions of increasing importance in various departments of the company in New York. In 1908 he was transferred to the Hawthorne Works of the company at Chicago, returning to New York the following year as superintendent of the New York shop.

From 1911 to 1923 Mr. Bancker's activities were again centered in Chicago, where he was assistant general superintendent of the Hawthorne Works. In the latter year he returned to New York as assistant vice-president and in 1926 he was made comptroller of manufacture and president of the Manufacturers' Junction Railway Company.

Mr. Bancker is a member of the American Society of Mechanical Engineers and of the Railroad Club of New York. His home is in Summit, N. J.

The late Jay B. Odell, whom Mr. Bancker succeeds, had also been in the employ of the Western Electric Company for many years, both in New York and Chicago. A native of Iowa Falls, Iowa, he had come to the Western Electric immediately following his graduation from Cornell University in 1904. In addition to his connection with the concern in Chicago and New York, he was for three years in charge of Western Electric business in Richmond, Va.

James H. Bancker

Practical Suggestions for Plant Valuations

By CHARLES W. McKAY, M. E.*

CHAPTER II

TOLL & RURAL LINES
APPRAISAL OF THE _____ EXCHANGE
MAP No. SHEET No.
TAKEN BY
COMPILED BY

LOC.		POLES										CROSS ARMS						MISC.				LINE WIRE						COND.			
		HEIGHT FEET										SINGLE				DOUBLE															
FROM	TO	15'	20'4"	25'5"	30'6"	35'7"	40'8"	ETC.			STEPPED	PAINTED	SETTING						BKT. WOOD	BKT. MTL.	ANCHOR	GUY	SPANS OF WIRE	#12 B/S	ETC.				POLE ARMS	WIRE		
1	2																														
2	3																														

Fig. 2

In our last installment the subject of organizing proper gangs for the inventory of outside plant was discussed, briefly.

Obviously, when the subject of plant valuation is under consideration the question of paramount importance is that of obtaining an accurate inventory of the outside plant.

As we all know, the inventory and appraisement of the rural and toll plant present many difficult problems. This portion of the plant covers an extensive territory and, of a necessity, weather conditions must be considered. It is possible to accurately inventory and record fifty or more miles of toll and rural plant under favorable weather conditions. Under adverse weather conditions the inventory of the same plant might be retarded to the rate of fifteen or twenty-five miles per diem. Hence, naturally, the first problem that presents itself in the appraisement of a telephone property is the toll and rural plant.

This can be accomplished, very simply by adhering to the form suggested in Fig. 1.

In connection with the form, above referred to, it will be noted that large spaces are provided for the recording of the poles—by heights and top diameters.

The next series of columns are headed "Stepped," "Painted" and "Setting."

It rarely is found that rural or toll poles are stepped or painted—except in the case of terminal poles where rural and toll lines adjoin the city plant.

The column "Setting," however, is rather important. Obviously, it costs more to set a pole in rock than it does in loam or sandy soil. Quite frequently it is necessary to set poles through a stretch of rocky soil involving the blasting of the subsurface structure. Naturally, work of this kind is expensive—and proper additional cost data should be recorded therefore.

The next group of columns refers to the cross arms—and hardly needs further explanation.

The same may be said with respect to the columns headed "Miscellaneous," "Brackets," "Anchors" and "Guys."

Above the fourth group column will be found the caption "Line Wire."

It is hardly necessary to comment upon this group. The wire should be recorded according to size and gauge and according to the number of spans.

It will be noted that the left hand column is entitled "Location," "From," "To."

In recording the toll and rural plant, it is well to use county or township maps. On these may be denoted the location points, these same points to agree with the notation on the field sheet—1 to 2, 2 to 3, etc.

It will be noted that the spaces under these value captions are relatively wide. This is for the purpose of enabling the inventory man to take the poles in "runs"—as suggested under the caption 25' 5" poles.

At the end of the sheet—or day's work—these columns may be readily totaled up, as indicated at the bottom of Fig. No. 2.

Quite naturally the inventory of the city plant is more complicated.

It is advisable to record the poles individually.

A form for the recording of the city plant is outlined in Fig. No. 3.

It is advisable to use a key map in conjunction with the form suggested in Fig. No. 3.

The first group of columns are almost self explanatory. Column No. 1 provides for the pole No.—same to tie up with the number on the map. Column 2, 3 and 4 specify the ownership—whether the pole is fully owned by the company making the inventory; is jointly owned by that company and some other company "say an electric light company"; or whether it is owned by "Others." By the terms "Others" is meant electric light companies, municipal companies, traction companies, etc.

The next group of columns are also almost self explanatory. Column 6—entitled "Kind"—meaning whether cedar, chestnut or whatnot. Column 7 provides for the recording of the total length in feet. Column 8 provides for the recording of the top diameter.

Columns 9 to 14 inclusive provide for

*Consulting Telephone Engineer, Wrigley building, Chicago, Ill.

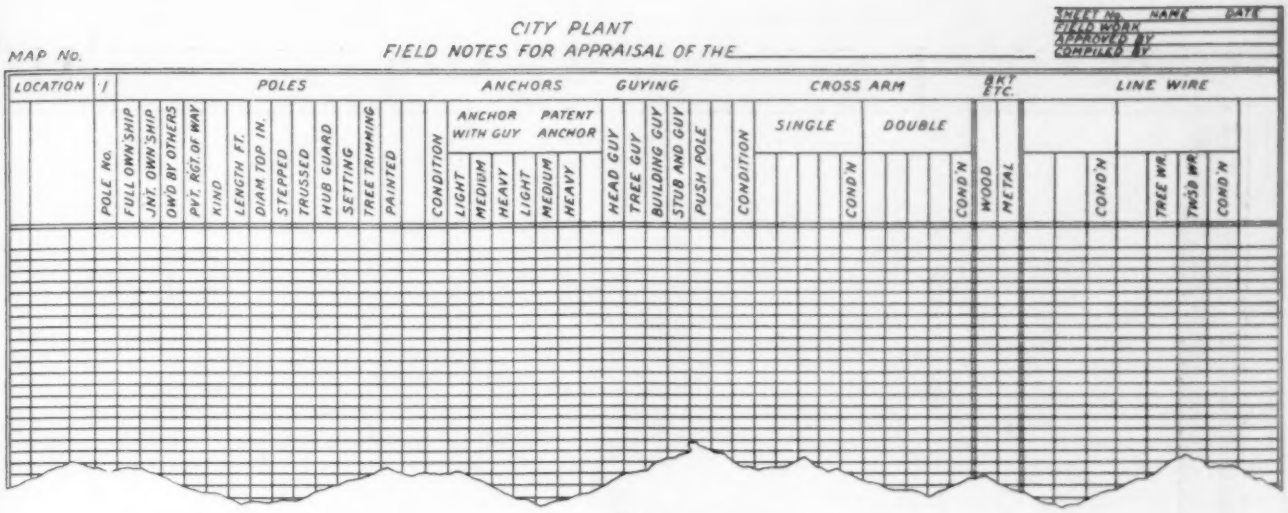

Fig. 3

the recording of such additional data as may be pertinent—such as stepping, setting, tree trimming, painting, etc.

The next group of columns pertain to the anchors. Next following will be found columns for the recording of data with respect to the cross arms—and, finally, a group entitled "line wire" which provides for the recording of the necessary data as to the size, gauge, type, etc., of the line wire.

Following each of the foregoing groups of columns it will be noted that there is a caption entitled "Condition." Obviously in these columns should be recorded a present working condition of the plant as found by the recording inspector.

This whole subject of field inventory will be discussed in more detail in the September issue of TELEPHONE ENGINEER.

Arkansas Midsummer Meeting Probes State Industry's Problems

Hot Springs, Ark.—Representatives from the leading telephone companies, of all classes, in Arkansas met here for a two-day session, July 18 and 19, and subjected the many internal and external problems of the state's telephone industry to expert consideration.

In planning for betterment of the industry's relations with its customers the Arkansas telephone men discussed not only the various aspects of publicity but gave lengthy consideration to improvement of plant facilities.

E. P. Ladd, Star City, president of the association opened the meeting with a general resume of conditions during the past several months, particularly during the flood period, and related instances of the value of association work. The flood brought to light again the spirit of public service that pervades the telephone industry for at many times during the formal and informal sessions of the conference there were related details of resourcefulness, fidelity to duty and notable heroism in the line of duty. The talk made by W. M. Graham, manager at Clarendon, Ark., about his experiences during the flood showed that the manager of a flood district telephone plant had plenty to do in not only protecting his own plant so far as he was able, but in providing one of the major safeguards for the entire community.

The flood rampage turned out to be one of the many bonds between the members of the association. L. M. Emerson of the Southwest Telephone Co., Prescott, told in detail some of the many advantages of membership in the association in his address, "Why I Am a Member of the Arkansas Telephone Association."

When the Arkansas men plunged into their practical problems, C. C. Watson, Inter-River Telephone Co., Lake City, brought up the matter of rural telephone lines. The backward Arkansas rural districts are being developed by the good roads movement and automobiles, so the state's telephone men plan to exercise as much supervisory care and extend as much co-operation as possible to the rural lines in order that their imminent development be along the right lines. W. S. Pedley of the Kellogg Switchboard and Supply Co. spoke on the probable increase in the ratio in the increase of telephone service during the next ten years and brought to this subejct a helpful combination of technical forecasting and the future view of the well-informed layman. Pedley's close connection with the practical problems of both large and small plants and his ability to pick for his material such of his findings as would be of most specific value to his audience made his address one of decided practical value.

"Velvet" Sales

Curtis Stout, connecting company agent for the Southwestern Bell, told the Arkansas men about the development of additional revenue past the degree they regarded as the saturation point. He stirred up the convention with many helpful suggestions relative to the successful solicitation of P.B.X. business, extension telephones, directory advertising and a general survey of each exchange's business possibilities as a starting point for a bigger business campaign. As a Southern pioneer Mr. Stout was in intimate touch with the state situation and put across his inspiring message in a way that meant dollars and cents to the conventioneers.

Another Southwestern Bell man, W. S. Campbell, district traffic chief at Little Rock, spoke on the employer winning the respect and loyalty of his force, citing some of the methods by which the Southwestern has achieved its splendid team-work. He laid down as a basic factor in corporate success the intense interest of each and every employe in the organization and told of the financial and social lineup necessary to the establishment of this community of interest.

Colorado Host to Pioneers September 19-21

Colorado Springs, Colo.—Telephone Pioneers of America, the Bell veterans' organization, will hold its annual meeting here September 19-21. It is expected that the meeting will be attended by more than 1,000 delegates. James T. Moran, president of the Southern New England Telephone Co., heads the Telephone Pioneers of America.

This Sig
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The supervisory signal and key has the two clearing out signals, the ringing and listening key and the ring back key combined in a single unit.

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Monarch
Telephone Equipment

On Inductance and Its Effects*

By F. J. DOMMERQUE
Fellow A. I. E. E.

75. Properties of Inductance

In section 29 on the action of the magnetic field it has been explained how a magnetic field is built up around a wire bent to a circle. If this wire instead of being bent into a circle is wound into a coil so as to form a number of circles or convolutions in close proximity to each other, the current flowing through the coil will produce lines of force around each of the convolutions and these lines being closed curves at right angles to the wire will link with each other and the convolutions of the wire.

We know that the number of lines through a wire, and therefore also through a coil of wire, depends on the current; when the current increases, the number increases, and when the lines decrease the number decreases also. The sum of all the lines of force passing through an area inclosed by any electric circuit is, if there is no magnetic substance in the vicinity, directly proportional to the current. If N is the number of lines threading through the circuit and I the current, then $N = LI$, where L is called the *self inductance* or simply the *inductance* of the circuit. For ordinary cases L is constant and will be so considered.

In the phenomenon we described in section 30 it was explained that when the lines of force are cut in such a manner that there is a change in the number passing through the coil an electromotive force is created. Therefore, whenever there is a change in the number of linkings between the lines of force and the turns of wire an e. m. f. is set up due to the existence of the magnetic field.

If the current in the coil is interrupted the magnetic field will disappear in a fraction of a second. This disappearance causes a collapse of the linkings of lines of force and thus a change of their relations, which again induces an e. m. f. which is the e. m. f. of self-inductance. The induced e. m. f. at the closing of the circuit, and likewise the current, is equal and opposite to the inducing current, but in opening the circuit the induced current flows in the same direction as the inducing current. These facts are laid down in "Lenz's Law," which states that *"whenever an induced current arises by reason of some change in linkings, the magnetic field about the induced current is in such a direction as to oppose the changes.* What has been said for a coil holds also good for two straight wires close together.

The magnitude of the induced e. m. f. is a function of the time rate of change of the number of linkings. In section 31 on induction we had expressed the time rate of change of the e. m. f. as $e = -\frac{dN}{dt}$; above we found that N varies as I; but that was for an unchanging current. For a varying current, which changes with the time, we must multiply by the operator $\frac{d}{dt}$, which indicates the time rate of change and obtain thus instead of $N = LI$ the equation $\frac{dN}{dt} = L\frac{dI}{dt}$. As L is constant and therefore does not change with the time, it does not require to be operated upon. If we insert the value of $\frac{dN}{dt}$ in the equation of the e. m. f. we obtain $e = L\frac{dI}{dt}$. This is the e. m. f. due to the existence of the magnetic field.

In an electric circuit a current can not set itself in motion, it must be created by some source of current, and the e. m. f. which is necessary to drive the current is equal and opposite to the e. m. f. $-L\frac{dI}{dt}$, hence $= L\frac{dI}{dt}$. A certain amount of energy is expended in driving the current and this energy, when the field disappears, is returned to the circuit. The energy of the magnetic field due to the current is $W = \frac{1}{2} LI^2$.

Inductances, like resistances, absorb energy from the circuit; this energy, however, is not transformed into heat, but stored in the magnetic field, and when the circuit is interrupted, appears in the form of an "extra current," tending to cause sparking between the contacts so interrupted.

The unit of inductance is the "Henry." When a circuit, having unit amount of induction, is so arranged that the current through it changes at the rate of one ampere per second, an electromotive force of one volt is produced in a direction opposing this current. The henry being rather large for practical purposes is not often used, in its place the millihenry = one thousandth henry is employed.

The dimension of inductance is C, that is, inductances are lengths, and theoretically can be computed from the geometrical relations of the circuit. The unit of length in the practical system being 10^9, the henry is 10^9 C. G. S. units. 1 microhenry = 1000 cm.

All telephone lines present a problem of induced currents. The starting and stopping of current flow or any variation in the flow of current in one wire will induce corresponding currents in a parallel wire. This induced current in long lines causes cross talk, which can only be overcome or minimized by transpositions.

76. Mutual Inductance

If a circuit, which may be designated as the secondary circuit, is placed in such a position as to be in close proximity to another circuit, which may be called the primary circuit, which carries an alternating current, that is, a current which changes its direction periodically, the varying magnetic field will react on the secondary circuit and set up therein an electromotive force, the direction of which is opposed to that in the primary circuit, that is the circuit will have inductance. If a direct or steady current were to flow in the circuit, it would find no opposition other than the resistance in the circuit.

If it be imagined that two circuits are so close together as to occupy the same space, it is evident that the total induction of the primary circuit will pass through the secondary circuit, and the e. m. f. set up in the secondary circuit will be equal to the inductance of the circuit, which may be represented by L_p. If the conditions be reversed, and the current be assumed in the secondary circuit, its inductance will act in similar manner in the primary circuit with an effect which may be measured by L_s. Now, if current flows in both circuits, each will react upon the other proportionally to the current in each. In this hypothesis the two circuits are assumed to be so close together that all the lines of force generated by each will be linked with the other so that a *coefficient M of the mutual inductance* may be defined as the total induction, linked with both the circuits, divided by the sum of the currents in both circuits. If, as in the previous supposition, two circuits are supposed to coincide in space, it is evident that M is equal or less than L_p or L_s; therefore $M^2 \leq L_s L_p$ and the maximum possible value of $M = \sqrt{L_s L_p}$.

77. Eddy Currents

It has been observed that whenever a mass of metal is rapidly rotated in a

*Seventeenth article on Telephone Mathematics and Physics.

magnetic field, its temperature rises, the heat being the direct result of electric currents (though flowing in minute circuits), which are induced in the metal and which are known as *"Eddy or Foucault Currents."* The e. m. f. of these currents is not high but as the mass of the metal is great and its resistance therefore small, the currents are sufficiently strong to considerably raise the temperature of the metal. It has also been observed, that an alternating magnetic field cannot penetrate deeply into a solid mass; a kind of screening effect is produced which makes solid masses unsuitable for alternating fields, and necessitates the use of laminated iron or fine iron wire as the carrier of the magnetic flux. Such provisions as laminated cores or core of soft iron wires are necessary in a great number of devices used in telephony.

The loss of power by eddy currents is porportional to the square of the e. m. f. and proportional to the electric conductivity of iron. The loss per cubic centimeter in ergs per cycle is $W = \epsilon \gamma NB^2$, where N represents the frequency of the alternating current, γ the electric conductivity of iron, B the maximum magnetic induction and ϵ the coefficient of eddy currents. Let V be the volume of the iron mass, then the total loss of power by eddy currents is $W = \epsilon \gamma N^2 B^2 10^{-7}$ watts.

ϵ for laminated iron plates of thickness d, is $\epsilon = \frac{\pi^2 d^2}{6} = 1.645 d^2 10^{-9}$, when γ is expressed in practical units. For iron wire $\epsilon = \frac{\pi^2}{16} d^2 = 0.617 d^2 10^{-9}$, if γ is expressed in practical units or 10^{-9} C. G. S. units, d being the diameter of the wire.

78. Coefficients of Inductance

In the following expressions C. G. S. units are employed, except where specified otherwise; l = length, d = diameter and r = radius, all in centimeters; and the values obtained are likewise in the same unit. To reduce these values to henrys, the value of L should be divided by 10^9, or by 10^6 for millihenrys. The currents are also in C. G. S. units and must be changed when amperes are used by multiplying by the proper value. Self inductance is symbolized by L and mutual inductance by M.

Single Conductor: Radius = r, length = l and distance from ground = h. $L = 2l \log_e \frac{2h}{r}$.

Two Parallel Conductors: Radius = r, interaxial distance = d. $L = 0.5 + 2 \log_e \frac{d}{r}$ per cm. of conductor; $L = 2\left(0.5 + 2 \log_e \frac{d}{r}\right)$ per cm. of circuit; $L = 2\left(0.0815 + 0.7411 \log \frac{d}{r}\right) \times 10^{-3}$ in henrys per mile of circuit.

Paper Cable Conductor: Radius = r, interaxial distance of a pair = 2d, $L = 4\left(0.25 + \log_e \frac{2d}{r}\right) \times 10^{-4}$ henry per cm. of cable.

Two Two-Wire Metallic Circuits: For explanation of letters see Fig. 83.

$$M = 2 \log_e \frac{d_{14} d_{23}}{d_{13} d_{24}}.$$

$$M = \left(0.7411 \log \frac{d_{14} d_{23}}{d_{13} d_{24}}\right) \times 10^{-3} \text{ in henrys per mile.}$$

Coil of a Single Layer: Length of coil = l, radius of coil = r, number of turns = S. $L = \frac{4\pi^2 r^2 S^2}{l}$.

Coil of Several Layers: Length of coil = l, radius of outer layer = R, radius of inner layer = r, number of turns = S.

$$L = \frac{4\pi^2 S^4}{3l^2} (R - r)(R^2 - r^2).$$

When the coil can be considered the equivalent of a solenoid, and w designates the length of the wire, then approximately $L = \frac{w^2}{l}$. If w is not known, but the number of turns n, the number of layers m, the inside diameter D of the solenoid and the thickness t of the wire over insulation, then $L = \pi n (D + mt)$. The above values are for long coils; for short coils, where the end effects cannot be neglected,

$$L = \frac{Sr^2}{0.01844\, r + 0.031\, h + 0.035\, l},$$

wherein S = number of turns, r = average radius, h = depth of winding space. It is supposed that $\frac{l}{r}$ and $\frac{h}{r}$ are very small.

Coil in Ring Form: R = radius of ring (center of ring to center of coil), r = radius of coil, S = number of turns. $L = 4\pi S^2 (R - \sqrt{R^2 - r^2})$.

If a second coil is formed on the first, having T turns of wire, the mutual inductance is $M = 4\pi ST (R - \sqrt{R^2 - r^2})$.

The mutual inductance of two concentric coils, l = length, the outer one having T turns, the inner one S turns, and a radius = r, $M = \frac{4\pi^2 r^2 ST}{l}$.

Coils for Large Inductance: The amount of inductance in a circuit depends upon its configuration. The most advantageous form is a ring (radius = R) of circular cross section (radius = r). Make R = 3.14r. When the ring is to have a quadratic cross section make R = 1.85a, where a = side of square. An iron core greatly increases the inductance, but the uncertainty and variability of the permeability μ makes it difficult to predetermine the inductance. It is possible to find the induction from the curves Fig. 28 and 29 when the magnetizing force in ampere-turns is known.

It may be remarked that the term "induction" is used to designate "magnetic induction" and the term "inductance" to designate the "coefficient of self- and

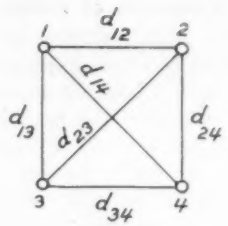


Fig. 83

mutual induction"; we speak also of the "coefficient of inductance."

79. Inductance Measurements

The coefficient of inductance may be determined by means of a Wheatstone bridge, a condenser and a variable non-inductive resistance. In the circuit diagram Fig. 84, A and B are the constant arms of the bridge, R the variable arm, S the variable non-inductive resistance and L the inductance to be measured, of

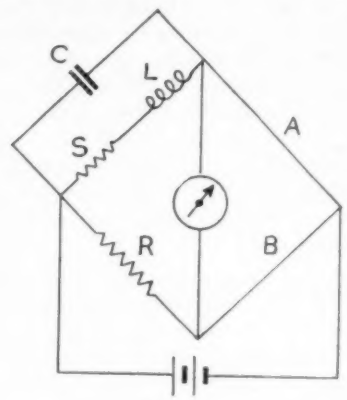
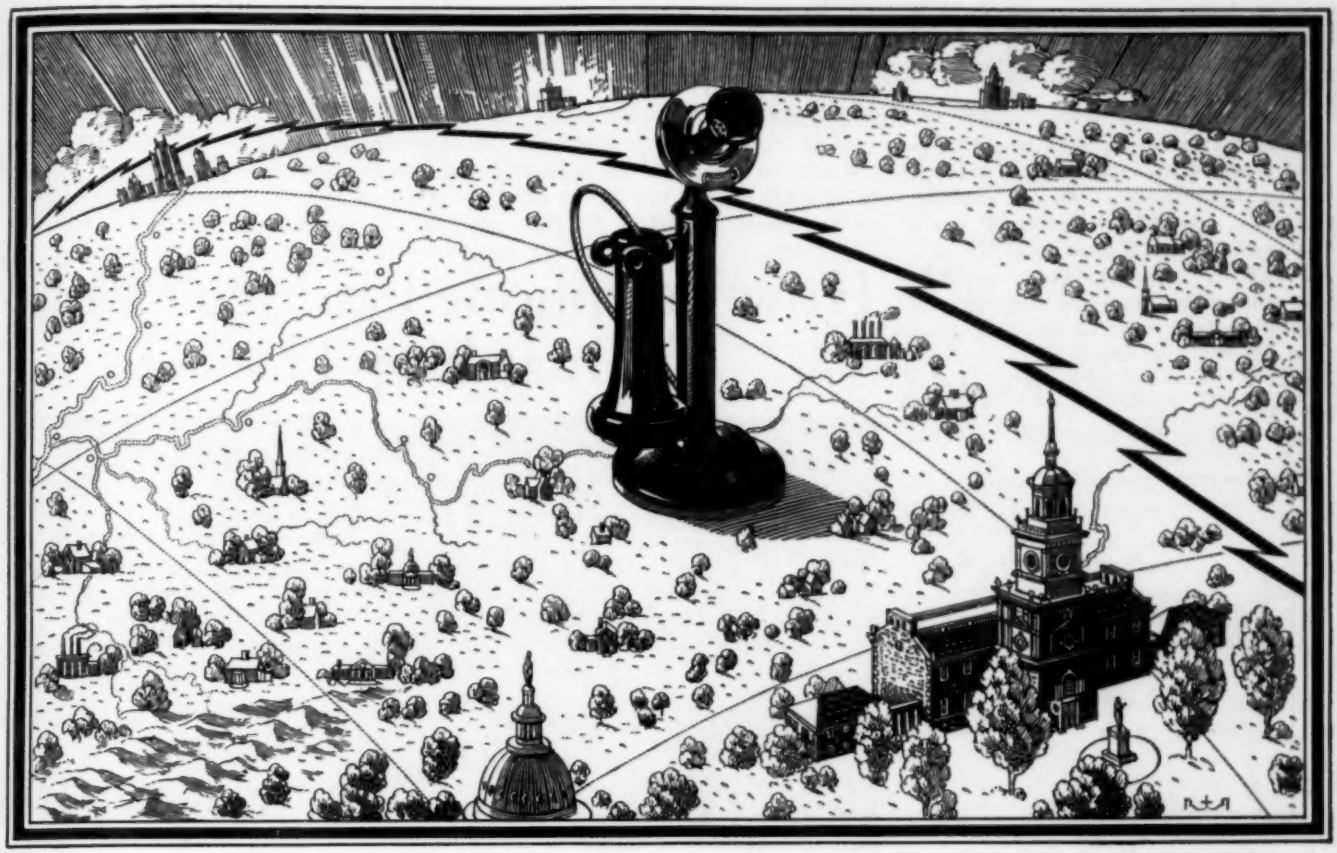


Fig. 84

which R′ is its ohmic resistance to a continuous current, while C is a condenser placed as a shunt across the arm of the bridge, in which S and L are inserted in series. It will be noticed in the diagram that the inductance L is represented differently from the ordinary resistance; this is done to indicate the difference between a non-inductive or ohmic resistance and an inductive resistance. Both kinds are wound into a coil, but they differ in their method of winding. Besides the inductive winding has as a rule an iron core.

The object of the resistance S is to bring the capacity required to balance the inductive resistance within reasonable limits. About this balancing of capacity and inductance we will learn something when we take up our alternating current discussions. The balance in the case under consideration is obtained by adjusting the mutual values of C, S and R until no deflection is produced on the galvanometer when the battery is inter-



The Traveler's Telephone

An Advertisement of

the American Telephone and Telegraph Company

AMERICANS are the greatest travelers in the world. They have knit the country together by steel rails and made it the largest and most prosperous business community the world has ever seen. Business, friendship and political solidarity are maintained by personal touch, by travel and the telephone. Wherever the business man goes in this country, be it thirty miles or three thousand, he is still within earshot of his office, his family and his friends. He can get them and they can get him, and for the longest call in the United States the day rate is only $12 and the night rate is only $6.

For the Bell Telephone System is an idea in force nationally. All the instruments are designed in the largest industrial laboratory in the world and made in the same factories to the one standard of fitness. All of the telephone builders, repairers and operators are trained to the same ideal and aim; stated by President Walter S. Gifford as:

"A telephone service for the nation, so far as humanly possible free from imperfections, errors or delays, and enabling at all times anyone anywhere to pick up a telephone and talk to anyone else anywhere else, clearly, quickly and at a reasonable cost."

rupted. Under these circumstances, if A and B are equal, the value of L is found from the expression $L = CR''^2$, in which $R'' = S + R'$.

The value of this method may be extended over greater ranges by giving A and B any desired ratios, as in ordinary bridge measurements. If, for example, L has a value of 0.4 henrys, R′ has a value of 10 ohms, C must equal 0.01 of L or 4000 m. f. Such a capacity would be beyond ordinary apparatus. By increasing R′ to 1000 ohms by the addition of the adjustable resistance S, C becomes equal to 0.4 m. f., an easily obtainable capacity.

To measure the inductance with the

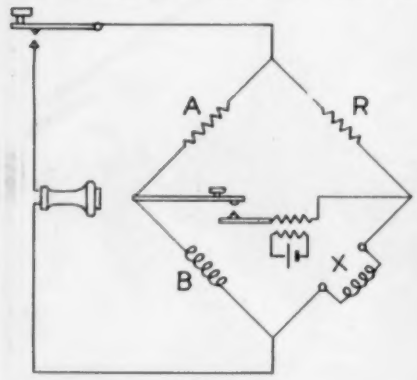


Fig. 85

testing set, the connections of which are shown in Fig. 70, the telephone receiver and alternating current posts are used and the set is connected up in a similar manner as for capacity measurement. The unknown inductance is connected to the line posts. See Fig. 85 for a skeleton connection diagram.

Use the 100 ohm coil in the bridge arm A and the 10 M. H. post on the B side. Then balance for minimum sound by varying the rheostat resistance exactly as in the capacity test, and when the minimum sound is secured, the following result exists: $L = 10\frac{R}{A}$, where L represents the unknown inductance in millihenrys.

Measurement of Mutual Inductance:

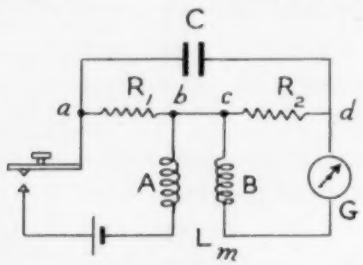


Fig. 86

To determine the mutual inductance of two coils, a circuit may be arranged as indicated in Fig. 86, in which the first coil A is placed in series with a key K and the battery and resistance R_1, while the second coil B is placed in series with the galvanometer G and the resistance R_2. Between the points a and d a condenser C is placed as a shunt. The other extremities b and c of the resistances R_1 and R_2 are placed in series. Opening and closing the key K produces induced currents in the coil B, giving deflections on the galvanometer which are proportional to $M - CR_1R_2$. By varying the capacity of the condenser, different deflections are obtained, which have the following relation: $\frac{M - CR_1R_2}{D} = \frac{M - C'R_1R_2}{D'}$, in which C and C′ are the different condenser values, and D and D′ the different corresponding deflections, from which the coefficient M is obtained by equation $M = CR_1R_2$ when D reduces to zero.

How Telephone Practice Leads in Guarding Time

Switchboard at 24 Walker Street, New York, through which London calls pass. Calculagraphs are between every two operators.

When an American manufacturing executive lifts up his telephone receiver to call a party in Europe via the New York to London radio telephone circuit, and holds a conversation at $25 a minute, it is necessary that the duration of his long distance call be timed with the same exacting accuracy necessary in recording the elapsed time of the workmen in his factory. In both cases, the time which elapses is a matter of dollars and cents, for which the modern business man has a good deal of respect.

And right here, in the measuring and recording of elapsed time—is a problem which the telephone engineer and the factory executives have joined hands in solving. The most modern methods of recording elapsed time have been rigorously tested by both telephone and industrial engineers in their efforts to establish a basis of constant accuracy in their records of time-duration, whether in periods of a fraction of a minute, or in duration of hours.

The calculagraph automatic calculating machine found at the toll boards of 99% of the entire world's telephone companies was not adopted, through a selection of newly-developed modern ideas. On the contrary, it was arrived at thirty-three years ago, and has been gradually developed to meet the ever-increasing needs of the telephone field.

One day in the fall of 1893, F. A. Pickernell, then Chief Engineer of the American Tel. and Tel. Company, was visited by a man with the first crude model of the Calculagraph tucked under his arm. Mr. Pickernell was engaged in an experiment with fifteen electrically operated clocks wired on a circuit with a battery and a master clock, but he was having trouble making them all move simultaneous. His visitor was Henry Abbott, then proprietor of a shop in which stem-winding attachments were produced at 4 Maiden Lane. When Mr. Abbott left the A. T. & T. office in Cedar Street, he had begun a relationship which has lasted ever since. His elapsed time recorder, which had been invented during the great New York blizzard in March, 1888, was tried out at the Cortlandt Street operating room of the company. After some difficulties and changes in the design of the original model, experiments and tests were continued in the Cortlandt Street office under J. S. McCulloh, then chief operator, and on March 8, 1894, the first machine was bought. That year single machines were sent to exchanges in Philadelphia, Boston, Chicago and San Francisco. On April 6, 1895, twenty machines were installed on a new switchboard set up in the operating room of the A. T. & T. Co. in Cortlandt Street. The development in the use of the Calculagraph is shown in the light of an interesting contrast when the situation of 1895 is placed beside that of today.

(*Continued on page* 38.)

Studying the Details of Telephone Work

By E. R. COLLINS
Wire Chief, Manitoba Telephone System

CHAPTER VII

Inductance.

In our previous experiments, we found that where a magnetic field was disturbed with in a coil of wire, that an induced current was set up. The ability of a coil to induce currents within itself, due to magnetic disturbance, is known as the inductance of the coil. The term which denotes inductance is the Henry. *An inductance of one Henry will give an induced E.M.F. of one volt, when the current of one ampere is changing its direction each second.*

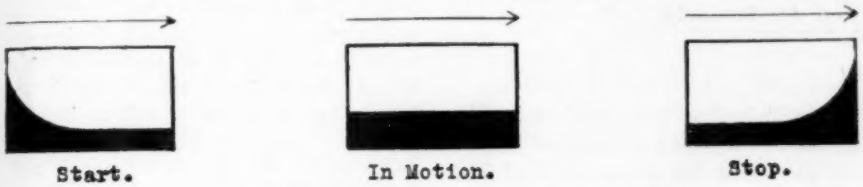


Fig. 46

The quality of inductance has a tendency to delay the action of an electromagnet, either when actuated by direct or alternating current. It is true that the delay is a very small period of time.

In Fig. 46 are shown three positions of a bottle partly filled with water. When the bottle is at rest on the table the water is level. Move the bottle and the water will pile up in a wave in the end of the bottle away from the direction of motion, or opposing the motion. If the bottle be moved steadily in the one direction the wave will drop back and disappear, and when the bottle comes to rest a wave is set up in the opposite direction. The arrows show the direction of the bottle.

In Fig. 47 is shown a set of curves to illustrate what has taken place. The heavy curved line represents the motion of the bottle, and the dotted curve the motion of the water. Referring to the figures of the drawing the following operations take place:

1. Motion of bottle commences. Motion of water is such as will build up a wave in the back of the bottle. *Negative motion.*

2. Motion of bottle continues in same direction, and the general motion of the water is in the same direction. The wave disturbance has ceased.

3. Motion of bottle has stopped, but the water endeavors to continue the forward motion, and piles up in a wave at the forward end of the bottle. *Positive motion.*

4. Wave subsides as the motion of the water ceases.

In the April issue, Figs. 22 and 24, we performed experiments which showed that a magnetic disturbance would induce an E.M.F. in the coils of an electromagnet. However, there is one step that we could not see in this experiment. When battery current is passed through an electromagnet, it causes a magnetic disturbance in the core. This magnetic disturbance must necessarily induce an E.M.F. in the winding of the coil. And since the induced E.M.F. is always opposite in direction to the current which set up the disturbance, it follows that there must be present in the coil as soon as the battery flow commences, an induced E.M.F. opposing the flow of the battery. However, as soon as the magnetic field is fully extended due to the steady force of the battery, the magnetic movement will cease and the induced current die out.

In Fig. 49 is shown the action that takes place when battery is passed through an electromagnet.

1. Battery commences to flow.
Magnetic disturbance commences.
Counter E.M.F. commences to oppose the battery. This is a negative action and is shown below the base line of Fig. 48.

2. Magnetic Field fully extended. Disturbance has stopped, and therefore counter E. M. F. drops to zero.

3. Battery is cut off. Magnetic field commences to draw in or there is another magnetic disturbance in the opposite direction to the first. A counter E. M. F. is set up which has the tendency to continue the flow of the battery and retain the magnetic field intensity. Therefore the magnetic effect of the core will continue a short period of time after the battery has been cut off. This delayed feature is made use of when designing slow acting relays. These will be dealt with under relays. The magnetic property of the coil opposes a change in the rise and fall of current being passed through the coil by the induced currents set up. This property is termed inductance.

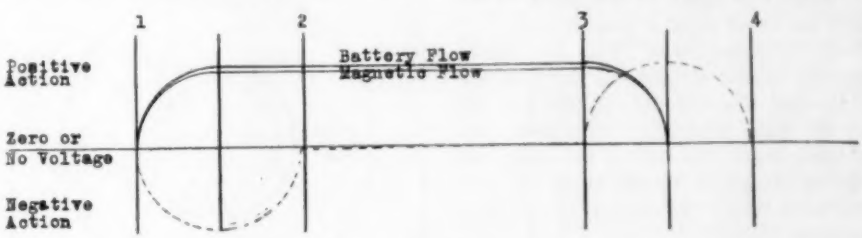


Fig. 47

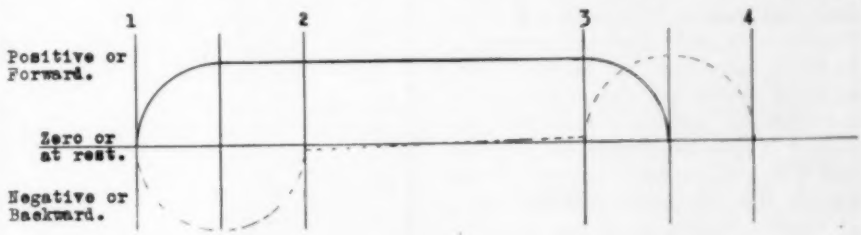
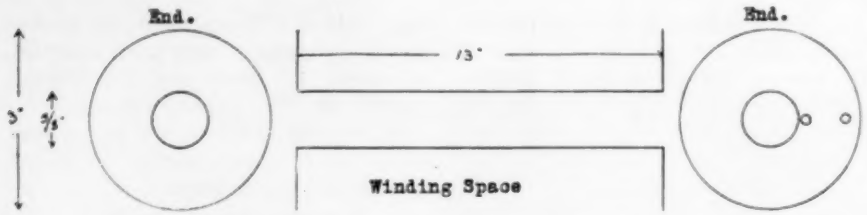


Fig. 48

Reversing the direction of the current

through an electromagnet will reverse the polarity of the core. Therefore there must be a complete change of the magnetic field for each change in the direction. Since the magnetic property of the coil opposes any change, it follows that changing the direction of the flow of the battery will cause counter currents which will suppress the flow of such changing current.

For our next experiments we will require a special type of coil. Those working in Strowger automatic exchanges will find a spare master switch solenoid Coil D28870 and the Core D79238. The coil is 50 ohms resistance. The core slides into the solenoid coil. For those not having this equipment, the following coil can be made up.



Dimensions for Copper Spool for Solonoid using a 14" Machine Bolt for Core.

Fig. 49

Fig. 49.

In Fig. 49 is shown the construction of a copper spool which is made to fit over a 14-in. machine bolt such as used to bolt cross arms to the poles. Wind into the spool about 2 pounds of No. 22 S. C. C. magnet wire. This coil can be quickly wound by slipping the bolt into the bench vice, and the coil over one end of it. Make a handle with a small machine screw in one end of the spool, and the spool can be turned easily to wind the wire. Wind the wire on as evenly as possible.

The resistance of this coil will be about 20 ohms. If this were connected to the 24-volt battery, here would be a little over 1 ampere of current passed through it according to ohms law. In Fig. 10 and 12 of the April issue, are two Solenoid Coils. We found by experiment, that these had magnetic properties. Therefore having magnetic properties, they have inductance, and having inductance will oppose any change in the rise and fall of current. However, the amount is quite small. Suppose we connect this coil to 110 volts alternating current, there would be over 5 amperes of current flowing according to ohms law.

Fig. 50.

In Fig. 50 we show a 25-watt lamp connected in series with 110 volts dry battery, and with 110 volts alternating current but there is no change in brilliancy. In the lamps we have pure resistance, but no inductance, hence the changing of the direction of the alternating current has no effect on the brilliancy of the lamp. Ohms law could be used to determine current flow if the lamp resistance were known.

Fig. 51.

In Fig. 51 we show the same arrangement, with the exception that we have added the 20 ohm coil in series in each case. Here again there is no difference in the brilliancy of the lamps although both will be less brilliant than in Fig. 50 due to the adding of resistance.

Now repeat the experiments of Fig. 51, but slide the 14-in. bolt into the center of the coil in each case. The bolt has no effect for the direct current but a slight dimming will be noticed for the alternating current. If a 100-watt lamp were used the lamp would go out with the alternating current when the bolt was inserted. By adding more iron to the coil we have increased the magnetic field, and having increased the magnetic field we increase the possible disturbance, and hence the counter E. M. F. With the 100-watt lamp the counter current is such that it stops the flow of current in the coil.

If the iron core is left inserted for some time with the alternating current flowing through the 100-watt lamp, it will be observed when the current is cut off and the core pulled out, that the coil is warm, but the iron core will be quite hot. The heat evidently is not due to the flow of current since the lamp is out, but due to some action in the iron which had set up the head. This heating effect is due to the property of the iron which resists magnetic change, and is known as *hysteresis*. We had an example of this in Experiment 7 of the March issue. If you are fortunate enough to have a harmonic converter in your exchange, you can try the effect of the coil and bolt with the different frequencies of the converter. Mark with chalk on the bolt the position where the lamp goes out. You can at least compare the office generator which will be from 16 to 20 cycles,

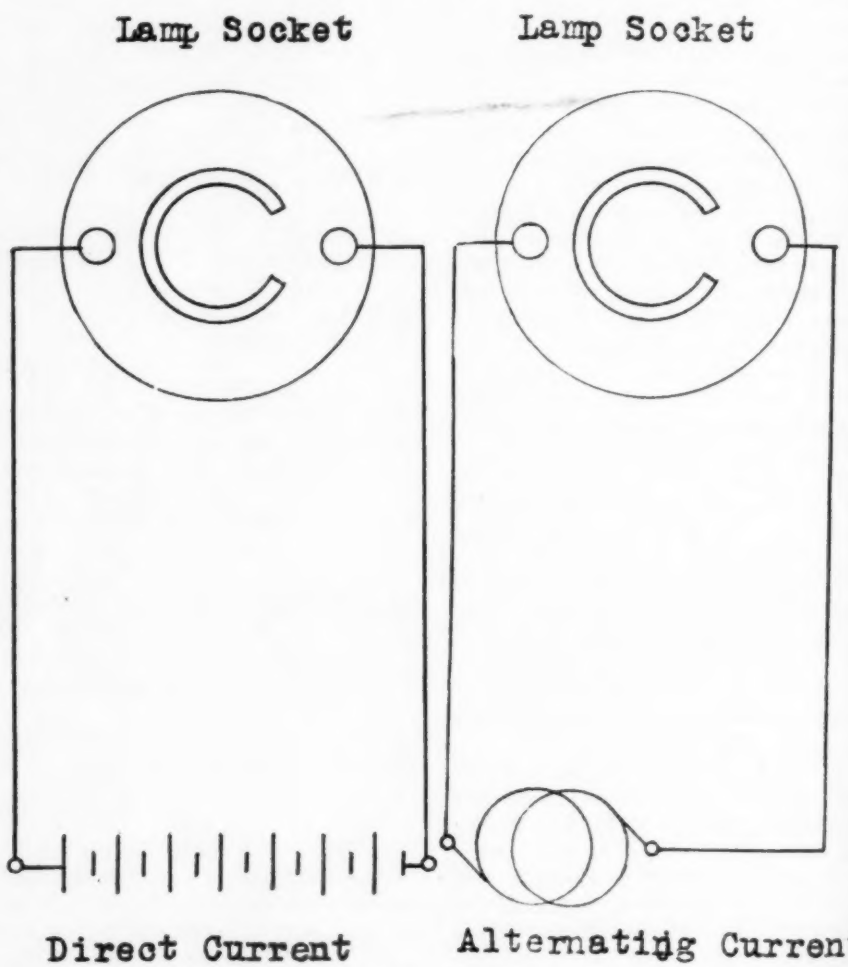


Fig. 50

with the lighting current which will likely be about 60 cycles. It will be observed that the higher the frequency, the less iron is required to put out the lamp. Or in other words the resistance offered by a certain inductance will be greater for the high frequencies than for the lower. Therefore to determine the effect of inductance to an alternating current, we must know the frequency of the alternating current. This effect we call reactance.

Reactance.

To find the reactance of the coil we must know the inductance of the coil in henrys, and the frequency of the current to be used, and a constant quantity which is 6.28. We will not deal with calculations by which this 6.28 is found. Suppose we have a No. 38 A polarized ringer fully assembled. The resistance of this to direct current is 1,000 ohms. The inductance is 3.2 henrys. Find the reactance to 16 cycle ringing current.

Then we multiply (6.28 x inductance in henrys x frequency) or (6.28x3.2x16). Ignore the decimal places and multiply straight. Then count off the number of decimal places from the right, and we have the reactance of the ringer as 321.33 ohms.

The reactance of the same ringer to 1,000 or voice frequencies would be (6.28 x inductance in henrys x frequency) or (6.28x3.2x1,000) or 20,096 ohms reactance. So we find that with voice frequencies the reactance becomes very high.

Impedance.

The word impedance is used to denote the combined effect of reactance, and the resistance offered to direct current in ohms. We cannot add these two quantities, to find the total resistance.

We find the impedance as follows:

Add resistance squared, to impedance squared, and take the square root of the total.

For the 98 ringer with 1,000 ohms resistance and with 321 ohms reactance to 16 cycles write:

Resistance squared or 1,000 squared or 1,000x1,000.....1,000,000
Reactance squared or 321 squared or 321x321 103,041

1,103,041

Take the square root of 1,103,041 and we have 1,050.2 ohms impedance offered to 16 cycle current.

For 1,000 cycle current the impedance works out to 20,120 ohms resistance.

Knowing the impedance offered to an alternating current of a given frequency and voltage, we can compute by ohms law the amount of current passing through the coil.

Summing up we have the three terms, Inductance, Reactance and Impedance.

Inductance is that quality of a coil, which gives it power to induce currents in its own winding. This is denoted in terms of the *Henry*.

Reactance is the resistance offered to an alternating current of a given frequency by a given inductance. This is expressed in ohms.

Impedance is the combined resistance offered by any coil due to reactance and ohms resistance of the wire in the coil.

Resonance.

There is another characteristic of the effect of alternating current when used with inductances, known as resonance. When a circuit is resonant to a certain frequency, it offers practically no resistance to that frequency.

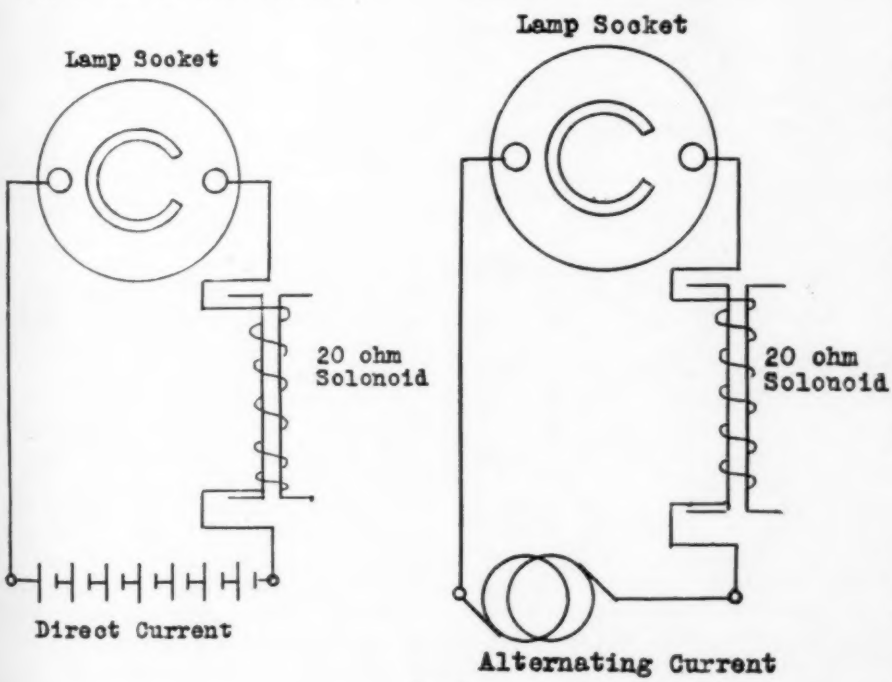


Fig. 51

An illustration of this principle can be found by using a spiral spring and a weight. The spring represents capacity, and the weight inductance. Pull the spring out to its full length, and let go. It goes back with a snap. Energy was used to pull the spring out, and all that energy was given off instantly when the spring was allowed to go back. Now hang a weight on the spring and pull the spring down, and let go. The spring will pull up and then extend and will oscillate up and down for some time before it comes to rest. It will be noticed that this oscillation keeps a certain time frequency. Repeat the experiment using different weights and different springs, and note that with each combination there will be a certain natural frequency of oscillation.

When the spring and the weight are oscillating at their natural period, they can be said to be resonant. A slight touch of the finger at the proper time will keep up the motion easily, but try to shove up on the weight while it is coming down, and more energy will be required.

We can build electrical circuits which will be resonant to certain frequencies. To illustrate this connect the solenoid and plunger with a 100-watt lamp in the 60-cycle lighting current. Shove the bolt in until the lamp is out. Now take a bank of ½ M. H. condensers and connect in series with the lamp and coil, in such a way that the capacity of the condensers can be increased one at a time. It will be observed that when enough capacity is added in series with the lamp and inductance coil, that the lamp will light again. What we have done here is to make the circuit resonant by leaving the inductance at the same value that kept the light out, and adding the condenser to the circuit. It must be remembered, that the reactance of inductance increases as the frequency of the current increases, and that the reactance of capacity decreases as the frequency of the current increases. The result of the two quantities inductance and capacity in series, produce what is known as electrical resonance.

Exercise.

Find the reactance and impedance of the following pieces of equipment, for 16-cycle and 1,000-cycle frequencies.

Equipment	Inductance	Resistance
No. 12 A Retardation coil	1 henry	165 ohms
Receiver No. 122	.036 henrys	80 ohms
Receiver No. 144	.033 henrys	80 ohms
Receiver No. 157	.280 henrys	600 ohms

(To be continued)

Quito, Ecuador—The Allmaenna Telefonaktiebolaget L. M. Ericsson has received an order from the Government of Ecuador for the complete reconstruction of the telephone system in Quito, the capital. The new system will be equipped to serve 2,000 subscribers to begin with.

How to Read Telephone Circuit Diagrams

By DAVID S. HULFISH

CHAPTER VII

(Copyright, 1927)

CHAPTER VII

Switches for carrying heavy currents, such as are associated with motors and generators, usually take the symbols of Figs. 418 to 421. Fig. 418 shows a three-pole single throw switch; Fig. 419 shows a two-pole double-throw switch. Fig. 420 shows a two-pole single-throw switch with fuses mounted either as a part of the switch, or adjacent to it. In Fig. 421 it is clear that the fuses are mounted upon the blades of the switch. A power switch symbol is shown also in Fig. 222.

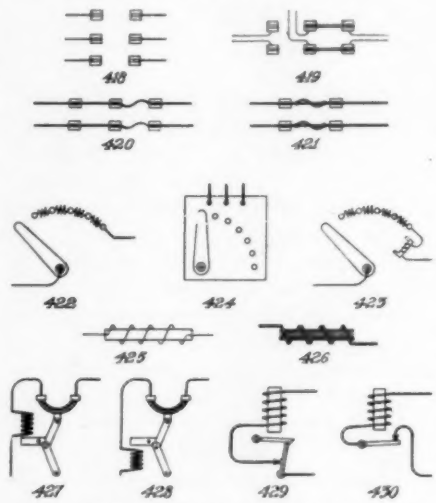
A direct-current motor is started by a variable-resistance device called a rheostat. This device seldom varies from the symbols of Figs. 422, 423 and 424. Fig. 422 shows the movable arm and variable resistance; Fig. 423 shows in addition a holding magnet. Fig. 424 shows the mounting of the electrical elements without showing the elements themselves, and shows also the three leading-in wires, for such a starting box usually has three binding posts.

The talking circuit of a common battery or central energy telephone exchange having but one battery is connected to the battery at all times, and when the charging generator is connected with the battery the sound of the commutator of the generator sometimes may be heard upon the telephone lines. To prevent this sound from reaching annoying proportions, choke coils are used; symbols for choke coils are shown in Figs. 425 and 426.

The power circuits, and particularly the charging circuit of the main batteries, are provided with devices for opening the circuit in case the current carried becomes either too large or too small. Underload circuit breakers are shown in symbol in Figs. 427 and 430; overload circuit breakers are shown in Figs. 428 and 429. The symbols of Figs. 427 and 428 are of later origin, but are well authorized. In each, a circuit is held closed by a brush sustained by a toggle, the toggle being held by a latch lever which is the armature near the coil or helix shown at the left of the symbol. In the case of Fig. 427, the helix holds the armature to retain the toggle latched and when the current becomes an underload the latch will be released; in the case of Fig. 428 the helix does not attract the armature during normal currents, but an overload of current will pull down the armature and unlatch the toggle.

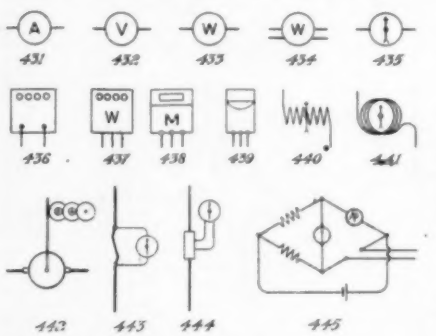
Figs. 429 and 430 show older symbols for circuit breakers.

The symbol for a measuring instrument upon the power circuits of a telephone exchange is simply a circle within



Figs. 418 *to* 430—*Symbols for power switchboard apparatus*

which is written a letter to indicate the nature of the meter. Fig. 431 shows symbol for an ammeter, Fig. 432 a voltmeter, Fig. 433 a wattmeter. In the wattmeter symbolized in Fig. 434 there are four leading in wires, two for bridging or potential wires and two for series or current wires. The two circuits of a watt-



Figs. 431 *to* 445—*Symbols for measuring instruments*

meter may be cared for by three wires; see symbols of Figs. 437, 438 and 439. In Figs. 436 to 439 a case with dials is indicated. The presence of dials or their indication, or of the type of case here shown, indicates that the meter is an integrating meter.

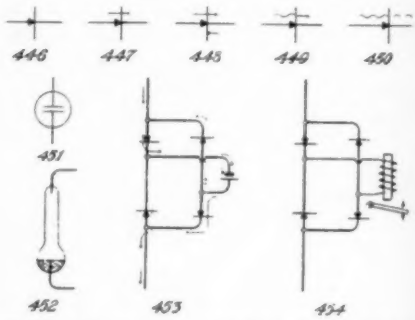
In the symbol of Fig. 442 an integrating meter is shown in a symbol which takes note of its electrical characteristics rather than of its dial or case. An integrating meter is essentially a motor driving a recording train of dials.

Galvanometer symbols, or direct-reading meters, are shown in Figs. 435, 440 and 441.

Figs. 443 and 444 show, in each instance, an ammeter and its shunt.

Fig. 445 shows the usual symbol for a complete Wheatstone bridge, a measuring instrument whose symbol will be encountered in diagrams pertaining to telephone testing. In this diagram, the two resistances at the left are the ratio arms of the bridge. The circle R is an adjustable resistance, and in the middle of the figure is a galvanometer, which in this case is merely a current detector.

The current rectifier is an instrument usually associated with the power board and the charging of small storage bat-



Figs. 446 *to* 454—*Symbols and circuits for rectifiers*

teries. Fig. 452 shows a symbol for the mercury vapor rectifier. This is substantially a picture of the device, which is a glass tube containing two conductor terminals and a quantity of mercury. Fig. 451 shows two conductor terminals within some kind of enclosure, and may represent either the mercury vapor rectifier or some form of electrolytic rectifier; it differs from a battery symbol in that its two electrodes are alike. Further, the symbol of Fig. 446 is used, sometimes accompanied by the light arrow as in Fig. 447, the arrow denoting the direction in which current is permitted to flow by the device. It would seem that the addition of a short arrow as shown in

Fig. 448 would make the symbol entirely self-explanatory.

Fig. 453 shows circuit connection for a set of four rectifiers in connection with a battery cell and an alternating current wire. The vertical wire at the left of this figure is a wire carrying an alternating current. Both phases of the alternating current pass through the battery cell in the same direction, downward, owing to the action of the rectifiers.

In Fig. 454 the relay shown may be taken in connection with the four rectifiers shown to serve as an alternating current relay.

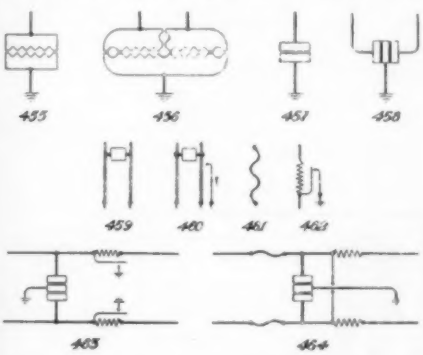
Protectors such as are used on telephone lines are shown in symbols of Figs. 455 to 464.

Fig. 455 shows the simplest form of saw-tooth or open-space lightning arrestor. This consists of two metal plates having points near each other, one of the plates being connected to earth and the other to the telephone line wire. Its theory of action is that because of the inductance in the telephone apparatus any charge of electricity acquired from a lightning flash will jump the narrow gap and thus pass harmlessly to earth rather than traverse the windings of the magnets.

In Fig. 456 a device of similar nature is shown, elaborated for two line connections and for switching plugs.

A more efficient open-space lightning arrestor is formed of carbon blocks spaced near each other; this is the subject for the symbols of Figs. 457 and 458.

Fig. 459 shows symbol for a heat coil, or sneak current protector. The two

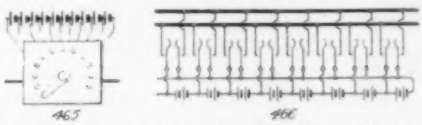


vertical springs have a normal tendency to spring apart, but are held together by the heat coil between. This heat coil when a predetermined degree of warmth is reached will release the springs, which then separate and break the circuit. In Fig. 460 a contact is added forming an alarm switch.

Fig. 461 shows the accepted symbol for a fuse.

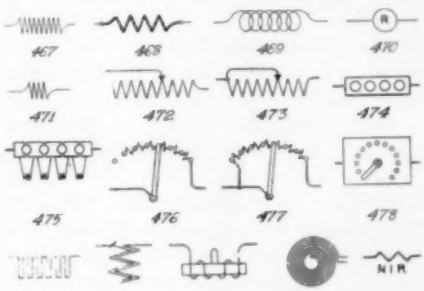
Figs. 463 and 464 shows the complete protective apparatus of a telephone line, using accepted symbols. Fig. 464 also shows fuses. The entire protective apparatus of either of these figures is built together mechanically, and the figures may be taken to represent single symbols for a complete line protection rather than diagrams composed of many individual symbols.

The draftsman has been called upon often to show some representation of electrical dimension. The only showings of absolute values expressed in standard



Figs. 465 and 466—Symbols for adjustable potentials

units of measurement, have been made by the use of figures set near the symbols. Relative value, wherein the diagram indicates that the dimensional value of one unit of apparatus is greater than the dimensional value of another unit of

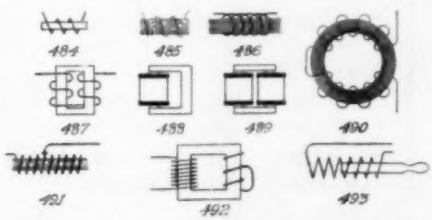


Figs. 467 to 483—Symbols for resistances, simple, adjustable and non-inductive

apparatus of similar nature, has been expressed by differences among the symbols.

Symbols for potential or voltage are given in Figs. 10 to 16, inclusive, and in Figs. 10 and 11 are shown two symbols representing potentials which differ from each other.

Symbols for adjustable potentials are not met frequently. Two symbols are



Figs. 484 to 493—Symbols for inductances, simple and adjustable

presented in Figs. 465 and 466, each being a grouping of simple units. Fig. 465 shows a multipoint switch associated with a main circuit leading out at right and left, to which the potential is to be applied, and a set of battery cells leading presumably to the contact points of the switch.

In Fig. 466, a series of battery symbols is associated with a series of switch symbols. Since the operation of any two of the keys simultaneously would short-circuit a portion of the battery, it becomes evident that but one key may be operated at any time. Any potential applied from the battery to the conductors at the top of the figure may be readjusted to a new value by releasing the key used and operating another key corresponding to the new value desired.

A possible symbol for adjustable potential is the symbol for the dynamo (Figs. 398, 409, 413, 416) with a showing of a field coil (Figs. 393, 394, 395) adjacent to the dynamo symbol, with a rheostat (Figs. 472 to 478), the rheostat being in series with the field coil.

Resistance symbols commonly appear in the forms shown in Figs. 467, 469 and 470. Fig. 467 may be taken as representing a side view of a series of helical turns; Fig. 469 represents a perspective view of the same; in Fig. 470 the key to the symbol is the letter R, an abbreviation for the word *resistance*.

Relative resistances are represented either (a) by a noticeable difference in the number of turns represented, or (b) by the thickness of the line representing the conductor, or by both methods combined.

The adjustable resistance or rheostat has its full quota of symbols. Usually such a symbol comprises a showing of resistance and of switch; see Figs. 475, 476 and 477. Motor starters (see Figs. 422, 423 and 424) usually involve the principles of symbols for adjustable resistances. In the device symbolized in Fig. 472, the circuit may be opened by moving the adjustable contact beyond the left-hand end of the resistance element. The symbol of Fig. 474 is a simplified showing of that of Fig. 475. The symbol of Fig. 478 is a simplified showing of those of Figs. 476 and 477.

Resistance without inductance, usually termed *non-inductive resistance*, is represented in the symbols of Figs. 479 to 483, inclusive.

The abbreviation NI adjacent to a resistance symbol indicates that the symbol is to be read as representing non-inductive resistance, while the abbreviation NIR adjacent to any symbol has a similar interpretation; this is indicated in Fig. 483.

The symbol of Fig. 479 appears to be purely arbitrary. It is easy for the draftsman's pen, and it is recommended by the United States Patent Office for use in diagrams forming parts of applications for patent. For these two reasons, the symbol of Fig. 479 is likely to have an extended use, despite the weakness resulting from its lack of inherent meaning.

Resistance with inductance sometimes is embodied in a structure or circuit solely for the feature of its inductance. In such an instance, the inductance being the essential feature of the apparatus, the symbol emphasizes the inductive nature of the apparatus.

Figs. 484 to 493, inclusive, show symbols for resistances having inductance, or

it may be properly said that the symbols there shown represent inductances.

Fig. 484 shows a core and a wire wound about it; this distinguishes from the simple resistance symbol of Fig. 467 by showing positively the fact that the wire is wound upon a core. Fig. 485 shows a core composed of a bundle of small wires; this type of core is used to increase the inductance of a helix, and a symbol showing such a core therefore emphasizes the inductive nature of the helix.

Closed-magnetic-circuit inductance units are shown in the symbols of Figs. 487 to 490, inclusive.

Adjustable inductances are shown in the symbols of Figs. 491, 492 and 493.

Relative values of inductance in separate symbols of a diagram may be indicated by variant numbers of turns about similar cores, or by variant positions of cores in similar helices such as that of Fig. 493.

The matter of differential and cumulative inductances, where a plurality of windings upon a single core are involved, has been discussed in connection with Figs. 258 to 264, inclusive.

Guarding Time

(*Continued from page 32.*)

Now we find at the company's long lines office, 24 Walker Street, New York, a system of 1,700 long lines circuits handled by a force of some 2,500 persons. Lines reach out to such distant points as Atlanta, 900 miles away; St. Louis, 1,000 miles across the country; Havana, 1,710 miles of land and water travel. Through no more than two intermediate connections, other lines stretch 3,360 miles to San Francisco, and 4,000 miles to the Catalina Islands. Every day 30,000 toll calls pass through the Walker Street boards, and the duration of every call is timed accurately and promptly recorded in permanent form, down to the quarter of a minute!

Time Major Factor

Perhaps in no other industry is time a factor of greater importance. When business men are glad to pay $25 a minute for talking over the air through the New York to London arrangement, considering it a matter of economy to do business by this magically modern avenue which science has opened up for them, they are buying space on the air at a rate which makes it important to both subscriber and telephone company that the measurement of the time consumed should be accomplished with the greatest possible accuracy. Here is a situation which permits no excuse for error. And the business man who uses this convenience—especially if he is a manufacturing executive—can well afford to heed the long experience and thorough success of the telephone engineers in all problems having to do with measuring time periods.

"Black Beauty" Poles Now Identified by Trade Mark "Red Tops"

Orange, Tex.—The Texas Creosoting Company, of Orange, Texas, states in their advertisement in the August issue of TELEPHONE ENGINEER that in the future the Texas Creosoting Company's "Black Beauty" poles can be more easily identified, both by the purchaser and by the general public. After the proper creosoting has been accomplished, the roof of each "Black Beauty" pole will be painted a brilliant red. This mark of identification will be in addition to the use of the usual dating nail.

The "red top" will be an exclusive, trade-mark feature of "Black Beauty" Poles, which will enable them to be easily recognized when seen in the line, on passing cars, or stacked in a pile ready for use.

This idea is believed to be an entirely new one in the creosoting field, and should find favor with buyers; since it expresses the confidence of the manufacturer in the uniform quality of his product.

The use of a dating nail is quite common among the progressive producers of creosoted material, but the Texas Creosoting Company is said to be the pioneer in branding its product with a mark which may be readily distinguished at a distance.

This company operates at Orange, Texas, one of the most modern and efficient commercial high-pressure treating plants in the country. The plant is located on tidewater, close to the source of supply of raw materials; and where the finest imported oils may be brought by tank ship. R. S. Manley is president and D. E. Roach sales manager of the organization.

Oklahoma Schedules District Meetings

Oklahoma Utilities Association, Telephone Division, is extending a very cordial invitation to attend these district conferences to be held at:

Sulrphur, Saturday, August 27.
McAlester, Monday, August 29.
Poteau, Tuesday, August 30.
Coweta, Thursday, September 1.
Ripley, Saturday, September 3.
Hominy, Monday, September 5.
Kaw City, Tuesday, September 6.
Garber, Wednesday, September 7.
Alva, Thursday, September 8.
Shattuck, Saturday, September 10.
Hammon, Monday, September 12.
Hollis, Wednesday, September 14.
Temple, Friday, September 16.
Apache, Saturday, September 17.

There will be no set programs at any of these meetings and the special feature will be that anyone can bring up for discussion any subject or problem that interests him most. Therefore comments and suggestions are requested for the success of these meetings.

The association has mailed a blank on which is to be listed subjects for discussion. Blanks are to be returned to the association's engineer, H. W. Hubenthal, 307 Local building, Oklahoma City, Oklahoma.

The following subjects have already been suggested for discussion at these meetings: "Plant and Maintenance Practices," "Traffic Problems," Commercial Subjects," "Radio," "Legal Matters," "Uniform Rules and Regulations," "Depreciation," and "Electrical Inductive Co-ordination."

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LINE AND DESK

SOME SAFETY SUGGESTIONS

Some excellent safety suggestions appear in an article in a recent number of The Northwestern Bell of which the following is an excerpt:

"Care of tools is an important point in guarding against accident. This is especially true of body tools such as the belt and safety strap, spurs and other equipment worn by the plant men while at work.

"Our safety depends upon the condition of our tools and equipment," says the safety code. "When we pause to reflect on the drastic results of a broken belt or ring, or a snap unhooked while high in the air, we will use every precautionary measure to eliminate this hazard."

"One excellent precautionary measure is never to let the safety strap or belt come in contact with cutting tools such as chopping axes, saws and others which are carried in a separate compartment on the construction trucks.

"Telephone men who use body belts for climbing poles assume the responsibility of inspecting them when they first get them and about once a week after that. Supervisors, too, make periodical inspections of this equipment in order to further safeguard against accidents.

"Using defective tools breaks safety rules," says the safety code, and that is not confined to only the spurs, body belt and other equipment which a plant man straps to his body. It applies to all of the tools used in doing telephone work.

"If a rope is worn or weakened so that it will not stand the strain it is ordinarily put to there is danger of it breaking when it is used for guying lines, lashing, or other uses made of ropes and a possibility of a workman or the public being injured.

"Sometimes the heads of drills become mushroomed and if they are used in this condition chips of steel might fly off when the defective drill is struck by a hammer. These pieces of steel might injure an eye. A split handle on a hammer is dangerous. As a matter of fact one could go on at great length to enumerate the dangers of using defective tools.

No matter how familiar a workman is with the safety code or other safety first instruction there is a danger of an accident if defective tools are used. The danger not only exists for him but also his fellow workers.

Regular inspections are made of all tools and any defects noted are remedied or the tools are replaced with new ones.

"Workmen, foremen and supervisors all make themselves responsible for the condition of tools used on the job and this is one of the ways our employes apply safety first and help to keep down accidents.

"Another thought on accident prevention which fits in with the times is exercising extreme care along the highways while the work is in progress.

"With automobile manufacturers turning out high speed cars and the state building better roads, there is more danger now of accidents along the country roads than there was a few years back.

"Every precaution possible is taken to prevent unsafe conditions and to protect the public who traverse the highways. Workmen also must use extreme care to prevent being injured by the fast moving traffic.

"In the final analysis it takes more than equipment in first-class condition or a careful set of rules as provided in the safety code. In the actual application of safety first, the telephone man must always remember the slogan—'The best safety device is a careful workman.'"

BUGS WE HAVE SHOT

Back around 1915, wireless experimenters were making detectors by laying a piece of carbon across the sharp edges of two razor blades, or reversing the process, by laying a needle across the edges of two sharpened pieces of carbon. Many persons called this type of detector a microphone.

This sort of early microphone played a part in the clearing of a case of trouble on the Waterloo-Des Moines line in 1915. S. B. Parr, Testboard Man at Des Moines, was listening to a circuit which was in trouble and heard a peculiar resemblance to the sound of a locomotive whistling for a crossing.

He remarked to R. N. Nicely, then Chief Testboard Man, that it sounded like a train.

Mr. Nicely sent the lineman to where the line crossed the railroad twice within a couple miles. Sure enough, the lineman found a piece of rusty hay baling wire across the pair. So far as we know this is the first use of a "self-made trouble microphone."—Chris Gasser, in *Long Lines.*

HELP! HELP!

For the first time since we assumed the pleasant task of "conducting" this department we have failed to receive a response to our call for Help. Not a single response has yet been received from our request for photographs or snap shots of H fixtures. Confident that there is some one who will take out the old picture-box and find us an example we are repeating the call for assistance.

TAR AND THE CAR

I laughed the other day when I saw a thomascat try to navigate a freshly tarred street. He gyrated, he demonstrated each and every and then several more intricate variations of the black-bottom. He looked like he was sorely, soully tired and tired in all his nine lives. Imagine having to maneuver four feet and a tail through such stickiness and carry on. But that's all right, that cat wasn't human and maybe he had to cross that particular street at just that place at that time. Maybe he didn't. He retreated. But why imitate the cat.

A freshly oiled or tarred road is about the height of insult to any automobile or truck, even aside from the danger of skidding, etc. If necessity, not thoughtlessness, recklessness, forces you to travel such a road, for the "love of 'Mike'" (Mike right now is the car-washer), go slow, be careful, avoid the puddles of tar or oil anyway. Just the other day a company owned roadster came to the garage for a rush wash, oil and grease operation. Such work under normal conditions is muscular, to say the least. The car though was covered with road tar, heavily sprayed from top of top to underneath the hood. No chance at all for fender to come loose, wheels fall off with all this tar vulcanizing. The windshield was mighty suitable for observing an eclipse of the sun, but very bad for seeing traffic.

Further explaining, tar or oil splashed on a car or truck with such reckless disregard becomes hardened and fast due to heat and wind drying. Road tar or oil

will never reach the windshield unless you drive fast through it—and then how would you stop (two, four, or twenty-four wheel brakes), if an emergency arose. Perhaps you got it due to following too close in line to the car or truck ahead.

Before a car can be washed all tar and oil must be removed and here is where you intrigue your car into added big expense, due to using solvent preparations and much tedious and hard work. Invariably too, a sponge, chamois, cleaning brush, water hose, work clothes are soiled and ruined by coming in contact with this tar and oil while trying to remove it or do other work on the car.

Many times, too, this oil or tar is transferred from outside to inside when a car is washed, oiled and greased, worked upon, shifted about in the garage. You yourself getting in or out of the car or truck will carry this tar or oil not only within the car, but on into your home on your clothing, shoes, etc. We hope you do. Then, we believe, you will have learned with emphasis far more than we can attempt to explain, even far better than Aesop's wife told Aesop more than 13,000 years ago, that, "A guy trying to be oily, is more thick than slick, for he inevitably will go ahead back."—Ray D. Ator in The Cincinnati Telephone Bulletin.

AN OLD ONE IN A NEW DRESS

When a plumber makes a mistake, he charges for it.

When a lawyer makes a mistake, it is just what he wanted, because he has a chance to try the case all over again.

When a carpenter makes a mistake, it's just what he expected.

When a doctor makes a mistake, he buries it.

When a judge makes a mistake, it becomes the law of the land.

But when the telephone operator makes a mistake—GOOD NIGHT!—Contributed by E. W. S.

SHE HAD RIGHT IDEA THAT WENT WRONG

A young man who sells Delco lighting plants had stopped on numerous occasions for meals and bed with an old couple who kept a grocery store at an Iowa village. The telephone service at this place was on a party farm line, where each patron is called by a certain arrangement of long and short rings.

During a recent stock show the old couple visited Chicago and stopped at a hotel in the loop. The salesman knew of their visit and, being in Chicago at this time, he looked them up, intending to take them out to see a good show and in this way make some return for the courtesies he had received at their home. Repeated efforts to reach them at their room by telephone failed, so he gave up the attempt to see them.

About a month later the salesman again stopped with the couple at the inland store and told them of his efforts to meet them in Chicago. "Well," said the old lady, "I guess we were in our room when you called, because the phone rang several times, but you know our ring is two longs and two shorts and you rang only one ring each time. I had a notion to answer but didn't want people in Chicago to think I was in the habit of rubbering on the line."—R. L. Parker.

New System Followed With New York Directories

New York City—In the delivery of the more than 3,000,000 volumes of the new summer issue of the New York City telephone directory which began June 27, a new plan of distribution, designed to speed up the delivery, is being followed.

Previously, the Manhattan-Bronx and Brooklyn-Queens books were delivered at the same time. Under the new plan the Manhattan-Bronx directory is being delivered first. When this delivery has been completed, the Brooklyn-Queens book will be distributed.

The Eggs Are All in One Basket

By the cord business **alone** Runzel-Lenz rises—or falls. Our successful and constant advance as cord specialists for more than a quarter of a century is substantial proof that it is wise to specialize.

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First Three State Session Wins Place Among Conventions

Jamestown, N. Y.—Those prime movers of the Tri-State Telephone Convention, held here July 14-16 started something that promises to have a place on each year's telephone convention calendar. The first Tri-State meeting was attended by approximately 350 telephone men and women, the greater number of them coming from New York, Pennsylvania and Ohio, but a scattering of the attendance coming from more distant points. These travelers who were far from their native soil were rewarded by a meeting that was rich in its practical benefits and by a couple of prizes; W. H. Bryant of Mobile, Ala., winning the long distance prize for men and Miss Anne Barnes that which was awarded to the woman who traveled the farthest to attend the session.

As an indication of how successfully this experiment worked out, it was decided to repeat a Tri-State session at Erie, Pa., in 1928, John Z. Miller of the Mutual Telephone Co., Erie, having invited the convention.

Arrangements made by John Wright, general manager of the Jamestown Telephone Corp., H. E. Bradley and J. G. Ihmsen, provided for an interesting program that was graced with a number of the Bell and Independent headliners. Wright and his associates also provided an entertainment schedule that rounded out the conferences in pleasant fashion.

Independent Bell Conference

During the Tri-State meeting President F. B. MacKinnon of the United States Independent Telephone association and W. Roy McCanne, W. L. Jacoby, W. H. Bryant, Frank Knapp and G. W. Robinson, members of the Independent executive committee, met with E. K. Hall, vice president of the American T. & T. Co., E. D. Nims, president of the Southwestern Bell, C. I. Barnard, vice-president of the Bell Telephone Company of Pennsylvania and H. O. Leinard, Cleveland, Ohio, all representing Bell interests for the purpose of discussing Bell and Independent relations with specific reference to property transfers.

Robert H. Jackson, general counsel of the Jamestown Telephone corporation, launched the convention program by presenting E. D. Nims, the Southwestern Bell chief, who reminded his audience that the future of the telephone business was not a matter for telephone men to consider in the same general manner that the future usually is contemplated by men who have plenty to do in the present, but in the light of an imminent period involving some amazing and weighty developments. President Nims went on record expressing a belief that J. J. Carty's prediction of a world telephone system would be borne out quicker than most expected. The Southwestern executive stated that we are not much more than on the threshold of telephone development. In the near future, he forecast, the telephone will be a part of every contractor's plans for a home, no matter how modest. As three of the outstanding periods in telephone history he placed the time of inception when the business gave promise of an industry that was some day bound to be successful and outstanding, the time of discovery of the real value of the telephone as an economic necessity, and the last period that in which recognition came to the telephone industry as a non-competitive business in which elimination of duplication and universal service were vital factors.

It is Mr. Nim's opinion that the industry has about completed its activity in merging and consolidating. He stated: "We have our feet on solid ground but that is not the end of the story—we have got to keep the solid ground under us; and in order to promote our ends and aims we must present a solid front against unfair aggression.

"The business stands today in a premier position. I do not believe there is any industry in the country that stands as high in the estimation of the public. Universal good service and the high plane on which the industry has been conducted, financially and otherwise, has placed us in an enviable position. This position we should guard jealously and do everything in our power to protect.

Lesson from Bankers

"There is one thing I have always admired in the banking industry—there is no business where there is stronger or keener competition, not only locally but between different sections of the country. However, bankers, as a whole, are always alert and ready to protect the industry. Let everything happen in the way of unfriendly legislation, or any practice that would have an ill effect put on the business, and they act as a unit in fighting for protection of their industry and its reputation. Often they come to the financial aid of their immediate competitors in order to save the reputation of the banking business.

"I believe the telephone industry should do the same thing and act as a unit to protect our reputation and to protect our high standing, financially and otherwise, that we now enjoy. The greater number of people now engaged in the telephone business are legitimate operators and have the same interest that all who are here have.

"This high standing of the telephone industry, before mentioned, holds out a great temptation to promoters to exploit the business. This is one instance where the industry, acting as a whole, has accomplished some splendid results. Some time back the president of the United States Independent Telephone Association called into conference his associates and representatives of the Bell companies to discuss this question among others. You are all familiar with the action taken. The result of that action has been more beneficial and widespread than any of us probably realize.

"While there are, of course, a number of so-called financial institutions that do not seem to care for anything except the immediate dollar, the most of them are high-grade and would not knowingly lend themselves to exploiting on the public securities that were not sound.

"This is only one instance of what may be accomplished by close co-operation of all of us who are in this business. There is another reason for close co-operation. In the last 30 years the various phases that the telephone business has passed through have developed one central thought which is recognized by all, i.e., the telephone business is a switching system, not the sale of a commodity like electricity or gas, and this fact alone made competition impracticable.

"Today, the telephone exchanges of the United States are practically all interconnected for interchange of service, and we have now a condition which makes possible, and perhaps profitable, a very high degree of co-operative effort looking toward better service.

Need Unified Effort

"The usage of telephone service by the public is constantly increasing and will doubtless continue to increase as service is improved. There are in the United States probably somewhere between 10 and 15 per cent of the telephones operated by persons, who for one or many reasons are unable to maintain the grade of service that it now appears the public demands; and if we are to consider the telephone business as a single switching service embracing the whole country, the importance of having the business prop-

erly cared for by all members of the system becomes apparent.

"It may be interesting at this point to express this thought concerning the telephone business—it is a form of communication, so also is the telegram and letter. However, both of these latter forms of communication consist of little more than the cold written word; and it is my feeling that if a telephone communication is made over circuits and equipment giving satisfactory transmission, there is an opportunity of transmitting personality to a degree which practically eliminates the letter and the telegram as direct competitors.

"The time, the opportunity for, and the need for, a better degree of co-operation is here. What form, or forms, this co-operation should take I am unable to say.

"It is true that in our technical work we attempt to plan for our equipment and materials needs five, ten or even 25 years ahead. We make elaborate surveys of communities, and forecast their growth in population and industries and plan for their needs. I do not think there is any danger that we will not have telephone facilities adequate for the future demands. Neither do I think there is any danger that the inventive genius for which our country is famous will die out and that improvements beyond our conception will be developed in the telephone art.

"In the telephone business itself, its organization, its methods and practices, I believe that we will not fail to keep pace with the progress in other lines. But are we giving sufficient thought to the selection and training of the men and women who will be called upon to operate this vast system? Are we giving sufficient thought to the training of people now engaged in the telephone industry and to those who in the future will make it their career?

Personnel Is Choice

"We have one great advantage in the selection of our men and women. There is no industry that I know of today in which employment is considered as high-grade by its employes and the general public.

"In talking with one of our plant men the other day, I asked him what he thought about the future of the telephone business from the point of view of the employe. His statement was that never before in his period of service extending nearly 30 years, had there been such an interest and good feeling toward the industry by the employes and the general public."

Mr. Nims concluded his address with a reminder of the responsibility of training young men properly to assume the burden of future leadership and advancement.

The Independent president, F. B. MacKinnon, commented on the spirit of co-operation that now prevailed in the industry. He spoke about the death of the old idea of the telephone industry being considered the heaven-sent monopoly of any one group, and mentioned the reminders of commission anent the demise this earlier conception of the allotment of the telephone business. He again stressed that both Independent and Bell interests overlook no method of protecting the industry against speculative activities and financial inflation. This matter of over-capitalization of merged properties also drew forth a sound warning from G. W. Robinson, president of the Tri-State T. & T. Co. He expressed the opinion that the future of the telephone industry depends very largely on the way in which the present situation of that division and financing of properties is handled. He gave voice to the belief that group management would work out reducing operating and overhead costs and doubted the practicability of operating many of the small companies and individual units.

High tribute was paid to the achievements of the Independent leaders with whom he had come in contact, by C. I. Barnard, vice-president in charge of operations for the Bell Telephone Co. of Pennsylvania. He referred to his observation of the work of President MacKinnon and Messrs. Wright, Paca and Miller, as revealing to him the valuable character of the work done by the Independent notables for the good of the industry. He also expressed the opinion that the operators' side of the meeting was one of the session's most beneficial aspects, stating that the girls probably got as much, if not more, than the men, out of such conferences.

The Pennsylvania Bell again was heard from when F. J. Chesterman, vice-president and general manager of the Pennsylvania's western area spoke on "Service, Looking from the Outside In." He emphasized the importance of putting "the human touch" into all of the telephone company's operations. He told of the harmony that must exist between the employes who come into contact with the public face-to-face and those whose contact is by speech alone. Some of the other high spots in his address concerned the wisdom of taking every complaint seriously, and the working conditions of the company employes. He stated that he personally read every written complaint that was made concerning the service in his territory. His analysis of these complaints and his recital of the ways in which their causes were eliminated or drastically reduced, made most practical convention material. He said that most of the written complaints were the result of verbal complaints not being properly handled. A careful explanation to the customer who is aggrieved—or who feels that way—is the policy that is followed. In contacts with customers, Mr. Chesterman said, five factors should be observed: courtesy, foresight, intelligence, helpfulness and sympathy.

J. G. Ihmsen, president of the Up-State Telephone Association of New York, followed up on the Chesterman address by referring to the manner in which the Pennsylvania Bell man had the courage to refer to the mistakes made by the telephone industry. "There is no one here," said Mr. Ihmsen, "who can sit back and say, 'everything is all right.' It might have been all right on Wednesday but on Thursday a thousand errors have crept in and unless we learn who is responsible on that job, our job has been incomplete. Reports coming to a man's desk saying that everything is all right are not always right and must be checked." Further reference to the Chesterman address was made by S. P. Grace of the Bell Telephone Laboratories and by John P. Boylan, president of the Rochester Telephone Corp.

In addition to briefly speaking of the work of the Bell Telephone Laboratories, Mr. Grace called attention to the Laboratories' desire to have the entire industry understand the policy of the research work being done. He and Charles Y. McVey, former president of the Ohio State Telephone Co., who was introduced to the convention, were two of the number of veterans on the program who referred to the pleasure of being able to meet so many of their old-time friends at the Tri-State session.

W. E. Hughes, safety engineer of the Rochester Gas & Electric Co. public relations department gave an interesting and valuable address on safety first work. He spoke of all his company's employes being instructed in the prone pressure method of resuscitation.

The difficulties of "the subscriber is always right" policy supplied the topic for John P. Boylan's remarks. Mr. Boylan suggested the employment of persistent and tactful education on the part of the telephone companies in order that they might not continue to shoulder the blame in many cases where they were entirely innocent.

W. S. Vivian, director of public relations for the Middle West Utilities Co., in speaking on "Applied Public Relations," said he considered public relations as nothing more or less than human relations. He told the Tri-State convention people that if they wanted successful public relations campaigns they must first have a definite objective. In the case of the Middle West company he stated that there was a regular schedule of employes' meetings carried out by employes. The executives stay very much in the

background so the employes won't get the idea that something is being slipped over on them. By having the employes conduct this schedule there is genuine and strong interest, marked development of the company's internal and external educational program, and the development of the employes as executive timber.

A well-planned program was conducted at a packed operators' conference which ran concurrently with the men's business end of the meeting.

The Tri-State session concluded with a lively banquet and dance.

Rap British Government Telephone Policy

By A. C. BLACKALL

London, Eng.—At the recently held general meeting of the Telephone Manufacturing Co., Ltd., the chairman, Fred T. Jackson, told some illuminating truths about the constitution of the British Government telephone service, in which he severely rapped the Department in charge.

He stated telephone development is being held up and deliberately curtailed as the necessary funds cannot be provided by the Treasury for carrying out the program for development and extension mapped out some time ago.

The brake put on telephone development by the Government by withholding finance is an extraordinarily short-sighted policy. He is quoted further: "As a country we have had some years of bad trade, and now there is a clear indication of a definite trade revival. There is an increasing demand for telephone apparatus by the public.

"The demand for public telephone apparatus could be greatly increased by proper propaganda. This has been proved by the work of the Telephone Development Association. The work done by this Association can only be described as small when viewed in comparative terms. Development must be done by the State on business lines. Efficient communication by telephone is of material importance. If the telephone is considered by the Government to be of such importance that it has become a State monopoly, surely the country is entitled to insist that the Government of the day should give adequate financial support to the permanent officials who are responsible for the efficient working of the system, and enable them to extend and develop the use of telephones all over the country. It is useless and unjust to abuse that section of the Civil Service responsible for the working of the system. Go to the root of the matter. The root is the Government, not only this Government, but any Government, whether it be Conservative, Labor or Liberal.

Phone Builds Trade

"It is an indisputable fact that quickness of communication is an essential in modern business, and the development of the telephone system in this country on the most intensive lines would have the effect of improving trade generally. The Government needs revenue, and yet, rather than effect greater economies in departments which are non-productive, it curtails expenditure in a department which is not only revenue producing, but of importance in assisting a trade revival.

"According to a leading article in the "Daily Express" earlier in the year, it was stated that there were over 17,500,000 telephones in use in America, as compared with under 1,500,000 here. The profit in America was over $30,000,000; the surplus here $2,750,000. Comparing profits here with profits there on the number of telephones stated, the rate here is better than America, and goes to prove the correctness of the statement that the Government is the obstacle to proper expansion here, and not a much abused section of the Civil Service. This is going on the basis that the telephone service is run on lines which produce a surplus, but is still limited as to expansion. Mr. Jackson said that he was of opinion that as a result of big expansion in the use of telephones, the cost of the service should be reduced.

English Critics

This brings one to the conclusion that the present system of financing telephone extension is wrong in this country. It is presumed that the Treasury cannot find the necessary funds. If a Government department vote is not utilized in its entirety in the financial year, the balance goes back to the Treasury and a new vote is granted for the new financial year; in addition, in the case of the telephone service the Treasury gets any surplus revenue, and the surplus is not carried forwards to use in the new financial year as capital expenditure or to endeavor to get more business. This system is wrong, and against the best interests not only of the telephone industry, but against the best interests of the country as a whole.

The critics maintain the telephone service should be handed over to a body which should be run on similar lines to other public service, such as the Metropolitan Water Board, or the Port of London Authority. At the head of this body should be placed the best business man obtainable, regardless of salary, and it is certain that, with the help of the permanent officials of the Post Office Service, there would be a very rapid and desirable increase in telephone development. Any capital required in addition to the telephone surplus could be obtained at a fixed rate of interest from the investing public in the shape of Telephone Bonds.

As far as the manufacturing interests are concerned, the present position is a lamentable one where solely engaged on telephone work. Lack of orders means that the manufacturer has to dismiss workers who have been specially trained up in the industry, with the result that they go on the dole, and perhaps a percentage drifts into other trades. In either case, it is a loss to the industry, which does not end even on a revival of trade for a new body of workers has to be trained up, which increases manufacturing costs to a very considerable amount.

Year's Growth in Britain is 8.5 Per Cent

London, England—A review of telephone statistics for the year ended March 31, which appears in the official journal, shows that at that date the total number of stations working was 1,508,786, an increase of 118,632 or 8.5 per cent on the previous year's total. Growth in Great Britain and northern Ireland was as follows:

	Total number of stations	
	At Mar. 31, 1926.	At Mar. 31, 1927.
London	488,499	532,066
England and Wales (ex. London)	751,876	817,356
Scotland	131,474	140,013
Northern Ireland	18,304	19,351

The total number of residence rate installations at the end of March was 303,061, of which 115,278 were connected with London exchanges. Included in a total of 21,934 public call offices were 3,051 street kiosks, of which 1,112 were provided during the twelve months under review. The London total increased from 245 to 465. A further 148 new exchanges were opened for service during the year, and a further 50 exchanges were in course of construction in March. During February 7, 192,382 inland trunk calls were made, an increase of 667,279 on the figures for the corresponding period of 1926. Calls made to the continent during February numbered 24,181, and calls from the continent 26,589.

At the end of 1926 the city and administrative county of London had 401,902 telephones, or one to each eleven of the

population. In the London telephone area, which includes West Ham, Croydon, Tottenham and other boroughs and urban districts, there were 519,969 telephones, or one for each 14 of the population. The average for the country is one telephone to 29.2 inhabitants, and London is well ahead of other places. Bournemouth has one for each 16 inhabitants; the ratio in Cardiff is 1 in 17, in Edinburgh one in 18.8; in Bradford and Blackpool one in 20, and in Manchester and Brighton one in 21.

Special Service Features for Added Revenue

By RAY BLAIN

It appears that many managers of Independent telephone companies discourage everything out of the ordinary in telephone service and refuse to install any kind of special service feature regardless of how urgently it is required by the subscriber. It is true that in many cases the special service requested is neither practical or possible, but there are many kinds of special services that could be utilized as a means of increasing revenue, and, at the same time prove a benefit to the service in general.

Many subscribers would be interested in one or more extensions if same could be connected in such a way to prove a real advantage. The average modern dwelling is usually of a size that the bell of the main set can be heard in every part of it, especially at night when everything is quiet. Anyone subject to night calls would be interested in a small handset extension without bell, installed near their bed so that a call could be received without getting up, especially so if it could be installed at a low rate which an instrument of this nature could be as its first cost is low. Extensions of any kind are always welcome to the exchange manager as these can be installed without additional central office or cable facilities. Some subscribers would be interested in a plug-in desk stand with jacks installed at convenient locations throughout the house or office if such service was available and commonly known.

One or more progressive manufacturers have recently placed on the market the so-called "French type" or combination handset known as the "Monophone" for common battery and the "Magnaphone" for magneto or local battery exchanges. This type of instrument is proving very popular, seems to be the ideal arrangement and is without a doubt the telephone of the future. Any exchange should be able to place a number of these instruments in service at a slight increase in the monthly rate.

Two lines keyed together with a number of extension telephones as described under "Line and Desk" in March issue of TELEPHONE ENGINEER will be the ideal arrangement for some subscribers. Upon visiting any Bell commercial office of any size it will be found that they make use of many similar features of keying two or more lines together. This should prove that the arrangement is desirable in any office where telephones are busy.

Loud ringing extension gongs can always be installed in noisy locations, and frequently in engine rooms or large open spaces such as railroad yards a whistle operated from steam or compressed air and controlled from the telephone ringer will solve the signal problem. Other subscribers might be interested in having a colored incandescent bulb light up when the telephone bell rings. Special power relays can be procured for this purpose that are controlled from the ringing current and close a circuit through the signal lamp and the house lighting mains. While in some locations a signal louder than normal is required, in others, one toned lower than the regular bell might be desired. In a case of this kind the gongs can be leaded on the under side, or replaced by one or two wooden gongs. If neither of these arrangements are satisfactory, a special low-toned signal can be purchased that should please the most fastidious. In some cases a ringdown drop to close a circuit through a buzzer and dry cells that will sound until the drop is restored manually will be desirable. In large warehouses and other locations where it is difficult to get anyone to answer the telephone this arrangement might prove a success.

Most telephone companies successfully avoid having anything to do with a buzzer system used in connection with its telephones. These buzzers are very desirable where a line is equipped with one or more extensions and all incoming calls are answered by one clerk who notifies the party desired to answer the call from one of the extensions. While such a buzzer system is not an integral part of the telephone, its function is so closely allied with it that its failure reflects on the telephone service. With the buzzer a party can be notified promptly to answer the telephone. Whereas, if a messenger is sent, time is lost while the line is held. Holding the equipment up in such cases is money lost to the telephone company as time lost is money lost to the subscriber, besides he may also lose a customer. I believe that the telephone company could well afford to install and maintain such buzzer systems at a regular monthly rate. If properly installed with suitable material including bell ringing transformers where A. C. is available, the system will require very little maintenance. If the telephone company will not handle such work but leaves it to some local Edison, who uses ten-cent-store push buttons and buzzers, annunciator wire tacked down with bare staples, then its future serviceability will be very uncertain.

In garages, factories or large machine shops one or more loud ringing gongs controlled from a push button at the main line telephone can be used very successfully in calling the foreman or others at work in the shops when they are required to answer the telephone, and thus avoid the sending of a messenger. When several parties are subject to call a code call system can be devised and the required party will answer when their call is sounded. Suitable loud ringing gongs for operation from alternating current can be procured and operated from the house lighting mains. In some shops a horn similar in construction and sound to a large automobile horn would be more desirable than bells and are easier heard in noisy locations. These horns can be procured that will operate from alternating current of various voltages.

If there is a hospital in your town why not wire up all the private rooms so that a telephone can be connected promptly with very little expense. Service could then be furnished for short periods at the regular rate without any installation or construction charge. This service will prove very desirable for the private nurse in serious cases and for the business man confined to the hospital for some minor ailment and in all cases make lasting friends for the telephone company.

Some subscribers could be interested in a small push button intercommunication system of five or ten stations, with two trunks and a ringing current and battery circuit to the main exchange. Where a small regular PBX is required the cordless type is most desirable as it takes up little space and can be operated by a clerk in addition to other duties. At night the trunks can be connected direct to certain stations for emergency service.

Some companies could no doubt maintain a time service at a real advantage. The master clock could be installed in the main exchange and subclocks rented to the subscribers using the cable pairs in the regular cables for connecting circuits.

A few telephone companies have made

a success of the business of furnishing radio programs to subscribers which are received over a centrally located receiving set and transmitted to loud speakers installed for the subscribers. The possibilities of this service I believe have as yet hardly been touched. It is very probable that some companies will, within a few years, be furnishing their subscribers with news events and moving pictures as the "Television" is now a reality.

There are without a doubt many medium sized cities where the telephone company could maintain the police and fire alarm system in a more efficient manner and with less expense than the city or the light and power company. The manager of the local telephone company might be able to interest the city fathers in some of the modern police and fire alarm systems to be installed and maintained by the telephone company. In this manner one power plant and one distribution system would answer for both which would be a great saving.

Many will claim that special service features require so much maintenance and due to the low rate for such service that they are not worth the effort. This opinion is usually based on makeshift arrangements and small dry cell type intercommunication systems not suited to conditions and not properly installed. Believe that if requirements are carefully considered in each individual case and the installation properly made that only success can result. It is surprising how many door bells are always out of order, as any book agent will tell you, but still people buy door bells and the one installed in a telephone man's house always works.

While local conditions must always control the amount and kind of service made available to the subscriber it is a proven fact that all equipment and auxiliary apparatus should be owned, installed and maintained by the telephone company if they are to be responsible for the service furnished. I believe that if the exchange manager would furnish the subscribers with any kind of practical service that they desire, and any that the manager thought they needed, and would pay for, that it would result in an increase in revenue, better service, and more satisfied subscribers.

OUR LITERARY DIGEST

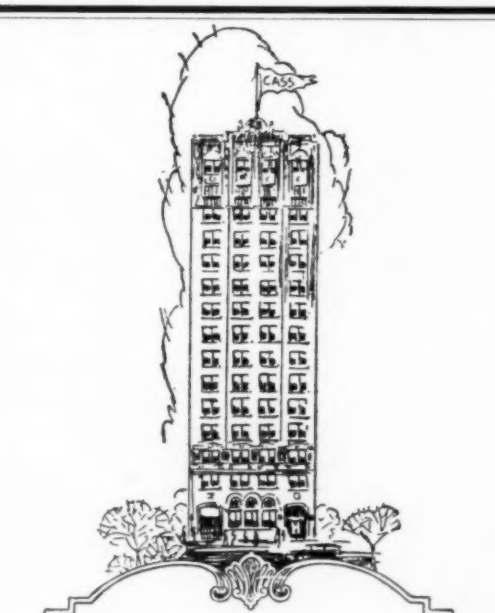
Review of Recent Publications on Telephony and Allied Subjects.

Protection of the Public. Safe Practices Pamphlet No. P. U., published by National Safety Council, Chicago.

This illustrated pamphlet is designed to give suggestions which will aid public utilities including telephone and telegraph companies in eliminating some of the hazards which arise from the construction and operation of their properties. It deals solely with the protection of the public assuming that safe practices from the standpoint of the workmen are being followed. Of particular interest to telephone companies are the suggestions relative to placing and protecting poles and underground construction proper and improper methods of which are shown by apt illustrations.

Introduction to Contemporary Physics, by Karl K. Darrow, Member Technical Staff, Bell Telephone Laboratories. D. Van Nostrand, New York.

Every reader of modern electro-technical literature should welcome this book which gives a comprehensive survey of recent advances in fundamental physical knowledge. Present day publications, particularly those relating to electrical communication, abound with references to the electron theory which assume a knowledge of the theory not possessed by those readers whose physics is that of two or three decades ago. Many readers are familiar with the series of articles by the author of the present work which has been appearing in the Bell System Technical Journal and to those it may be said that the text is more than a reprint



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of the various articles but is really a unified account of the phenomena which the neuclear atom model of Rutherford and Bohr is designed to interpret.

The author is not only a scientist, but apparently is something of a philosopher as is indicated by his discussions of the extent and limitations of our knowledge of the ultimate composition of matter. He is particularly insistent upon the discrimination between the "experimental atom," an object found in nature and endowed with observed and measurable qualities of mass. Magnetic moment and charge, and the various speculative atoms or atom-models, devised to imitate observed phenomena." The style is easy and readable and while some facts have been expressed mathematically, the mathematics do not obtrude themselves in a way to disturb the ordinary reader whose mathematics may be as rusty as his physics is obsolete.

Review of Recent Publications on Telephony and Allied Subjects.

Rundfunktechnisches Handbuch, II Teil, von Heinrich Wigge, Verlag von M. Krayn, Berlin.

This is a second volume of a German publication on radio broadcast reception. Like the first volume (reviewed, Dec. 1925) it contains both practical construction details and discussion of the theoretical principles underlying the apparatus described. The present volume deals with the more complex receiving sets embodying radio frequency amplification, the superheterodyne and the reflex principles. Chapters are also devoted to double-grid and other special forms of tubes.

Austria Reports Progress with State Telephones

Vienna, Austria.—Austrian Posts, Telegraphs and Telephones Department recently has issued its report for 1925 in which it states that for the first time porcelain insulators of Austrian manufacture were used, to the extent of approximately 290,000 pieces. The work of changing over the Vienna telephone system to automatic operation, commenced before the war, was completed, and 6,000 new subscribers connected in 1925. There are now about 70,000 telephone subscribers in Vienna, who are served by thirteen exchanges, the largest having 10,000 connections and the smallest 1,000. A new automatic telephone exchange has been completed in Linz; one is approaching completion in Salzburg, while work on one in Neustadt, Vienna, has been started. New international telephone connections have also been established between Vienna and Warsaw, Vienna and Pressburg, Vienna and Agram, and between Kufstein and Oberaudorf.

Simple Algebraic Development of Wheatstone's Bridge

By R. E. JOHNSON

The voltmeter is a very satisfactory instrument for use in making tests, when accuracy is not necessary, but when the exact location of trouble in the outside plant or the true ohmic values of coils, resistance units and other apparatus, the Wheatstone bridge arrangement is the most efficient method, due to the fact that it employs a zero method or balance.

The Wheatstone bridge usually consists of six conductors forming four points—one a source of electromotive force and another a galvanometer. Fig. 1 shows a simple unit.

The condition that exists when a balance is effected is usually stated B : A = X : R. Many making tests and using the proportion are not familiar with its development or the actual conditions that cause it. The following simple algebraic development states the condition of any method of testing with a Wheatstone bridge, in a concise mathematical analysis, so that anyone can obtain a clear understanding of the conditions, effecting the balance.

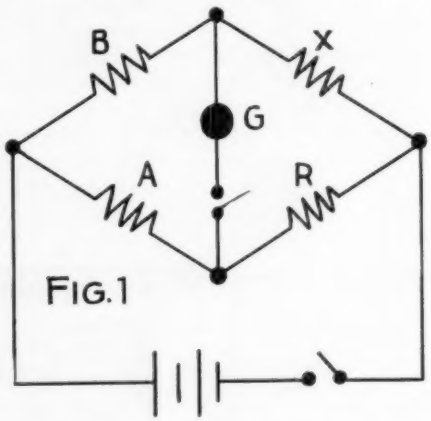

FIG. 1

Ohms law — $E = I R$

when E = Voltage,
I = Current,
R = Resistance.

Referring to Fig. 1 at balance: Let the current flowing in the upper branch = I_{bx} and the current flowing in the lower branch = I_{ar}. Then $I_{bx} = \frac{E}{B+X}$ and $I_{ar} = \frac{E}{A+R}$.

Substituting these values of I in each voltage drop we have—

E_b = voltage drop across

$$B = \left(\frac{E}{B+X}\right)B$$

E_x = voltage drop across

$$X = \left(\frac{E}{B+X}\right)X$$

E_a = voltage drop across

$$A = \left(\frac{E}{A+R}\right)A$$

E_r = voltage drop across

$$R = \left(\frac{E}{A+R}\right)R$$

When balance is effected $E_b - E_x = E_a - E_r$. The galvanometer is at zero at this point.

Substituting the individual values in the above equation we have:

$$\left(\frac{E}{B+X}\right)B - \left(\frac{E}{B+X}\right)X = \left(\frac{E}{A+R}\right)A - \left(\frac{E}{A+R}\right)R$$

and

$$\left(\frac{E}{B+X}\right)(B-X) = \left(\frac{E}{A+R}\right)(A-R)$$

$$\frac{B-X}{B+X} = \frac{A-R}{A+R}$$

clearing $AB - AX + BR - RX = AB - BR + AX - RX$ collecting $-AX - RX - AX + RX = AB - AB - BR - BR$

$$-2AX = -2BR$$

$$AX = BR$$

or

$$X = \frac{BR}{A} \text{ or } B : A = X : R$$

Applying this to measuring coils, resistance units, etc., insert the unit to be measured in arm X. The resistance can be determined approximately by the voltmeter or by trial.

Table for A and B arm settings (taken from standard text).

Value of unknown resistance.	A	B
Below 1.5 ohms.....	1	1,000
Between 1.5 and 11 ohms...	1	100
Between 11 and 78 ohms....	10	100
Between 78 and 1,100 ohms.	100	1,000
Between 1,100 and 6,100 ohms	100	100
Between 6,100 and 110,000 ohms 1,000		100
Between 110,000 and 1,110,000 ohms 1,000		10
Between 1,110,000 and 11,110,000 ohms 1,000		1

Set A and B arms correctly and adjust rheostat until galvanometer is at rest

at zero. Substitute the arm values in the formula and the resistance can be computed.

Example—20 ohm coil to be measured.

Insert coil in X arm.

According to table — A = 10 and B = 100.

Adjust resistance box until galvanometer is at zero.

Resistance box = 2 ohms.

Substituting values in formula $X = \frac{100 \times 2}{10} = 20$ ohms (value of coil).

The actual conditions as shown by the algebraic development would be:

Assume for convenience a test battery of ten volts. Then the current through the upper branch is 10/120 = .083 amp. And the current through the lower branch is 10/12 = .83 amp. Then drop across B = 100 × .083 or 8.3 volts; drop across X = 20 × .083 or 1.66 volts; drop across A = 10 × .83 or 8.3 volts; drop across R = 2 × .83 or 1.66 volts.

8.3 — 1.66 = 8.3 — 1.66 ($E_b - E_x = E_a - E_r$). Thus the balance is effected by zero reading.

Graybar Has New Home at Birmingham

Birmingham, Ala.—Scientific construction characterizes the new home of the Graybar Electric company at 1529-31 First avenue, North. An ever-increasing business, coupled with a demand for even better service than was possible at the old location, is responsible for the new house.

The building covers a lot 50x180½ feet. It is comprised of two floors containing approximately 18,800 square feet of floor space.

A loading court has been built into the building which will enable customer and company trucks to back in, under cover, and receive material from a loading platform at truck body level. A siding in the rear accommodates two cars. The platform is covered and at car door level.

Special accommodations include a conduit rack of five carload capacity, a two-ton electric elevator, and a main floor large enough to accommodate all such items as hardware; conduit, strand, iron, rubber-covered and weatherproof wire; glass and porcelain insulators; schedule material and standard package lines. This arrangement literally insures prompt and efficient service.

On the second floor are the general offices, fixtures and lamps, appliance stocks and exhibits. The second floor entrance is on the First Avenue side of the building.

Coloma, Mich.—Dr. O. M. Vaughan is president of Tri-County Telephone Co., a merger of Van Buren County Telephone Co., Dowagiac Telephone Co. and some properties of the Michigan Bell.

American Ideas Spur Spanish Building

American methods and American equipment are being used in the expansion of Spain's telephone system. The construction program last year alone involved an expenditure of $20,000,000. Building of distributing plants, conversion from overhead to underground cables, and changing local systems from manual operation to automatic in Madrid and eighteen other cities, together with extension of long distance lines, are items in the program of the Compania Telefonica Nacional de Espana, a subsidiary of the International Telephone & Telegraph Corporation, of New York.

The photograph shows a White 5-ton truck of the type of pole-planting and cable-pulling equipment being used in Madrid and other cities. There are six of these Whites being used in telephone construction in Spain. All have winch and derrick equipment, with trailers for hauling cable reels.

Telephone construction work in Mexico has been facilitated by similar pole and cable equipment on three 2½-ton White trucks and a 1½-ton White owned by another I. T. & T. subsidiary La Compania Telefonica y Telegrafica Mexicana.

Europe Makes Greatest Increase in 1925

The total increase in the number of telephones in Europe in 1925 over 1924 was in the neighborhood of 550,000, as compared with 501,000 for 1924 over 1923, up to that time the largest gain every recorded. In the same years the Bell System and connecting companies in the United States reported a net gain of 813,674 in 1925 over 1924 and of 906,449 in 1924 over 1923.

In Germany, a total of 202,839 telephones was added in 1925; in Great Britain, 115,632; in France, including Algiers, 77,249; in Belgium, 21,278; in Russia, about 20,000; in Sweden, 16,276; in Holland, 11,452; and in Switzerland, 10,491. Figures for Denmark, Italy, Spain, Poland and Szecho-Slavakia are not yet available in total, but all show about the same porportionate gain. In Germany this figured out a little over 8 per cent, in Great Britain 9 per cent, in France and Algiers over 11 per cent, in Belgium over 15 per cent, in Russia over 13 per cent, in Sweden nearly 4 per cent, in Holland 5 per cent, and in Switzerland over 5 per cent.

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FIRST IMPRESSIONS OF A MACHINE SWITCHING OFFICE

When the University office of the Chesapeake and Potomac Telephone Co. was opened recently in Baltimore, one of the visitors was Henry M. Hyde who gave his impressions in a article in the "Baltimore Evening Sun." That Mr. Hyde was able to give a realistic picture of the office without the use of technical terms is shown by the following article which we reprint through the courtesy of "The Transmitter":

"A huge, silent room. Only one or two men are in sight. It looks deserted. Standing on the floor is a series of frames, about eight feet square and, perhaps, two feet thick. In shape they resemble so many honeycombs. They are like honeycombs, also, in that each of them contains thousands of tiny cells—though all of these cells are empty.

"Running up and down the outside of these frames are brass rods—the diameter of your finger. Near the bottom of each rod is a tiny point of metal in a small knot of green-wrapped wires.

As you look one of the rods moves silently up the face of the honeycomb and the tiny point of metal catches in an empty cell.

"Watch the monkey jump," says your guide. There is something about the silent and mysterious operation to suggest a monkey on a stick.

The silence is almost uncanny. Yet, in this room at the moment at least a thousand telephone connections are being made. It is the automatic switching room of the new University Telephone exchange. Its electric brains, which unerringly make the right choice out of a hundred thousand possible choices, add the last touch of mystery to what remains the miracle of the telephone.

"Some 20,000 of the 120,000 telephone stations in Baltimore now make all their connections automatically, simply by twisting a dial until the number desired has been indicated. There is no longer a sweet, feminine voice inquiring "Number, please?" If you want to get a wrong number you are obliged to dial it yourself. The silent, mysterious, unerring monkey on a stick attends to it all. He can't make a mistake without raising so much hell with the machinery that all sorts of automatic and human inspectors and watchmen send in alarms, ring bells, flash red lights and turn things upside down until the error is corrected. This is more than enough to keep any self-respecting monkey in good order.

What happens when any subscriber whose phone is connected with the University, the Lafayette or the Liberty exchange takes the receiver of his telephone off the hook?

"Instantly, one of the brass rods starts to slide upward until its monkey can stick its finger in the right hole—which bears the name of the subscriber's telephone. When that operation is completed the monkey begins to sing in a low, sweet, soprano voice. The subscriber hears what is techincally called the "dial tone." That notifies him that the monkey and his comrades are ready for further operation. And it takes about one second.

"Suppose the subscriber is calling from a University station and wants to talk to a number in the Lafayette exchange. He puts his finger in the proper slot and revolves the dial to indicate "La." Instanly, another monkey on a stick, which is electrically connected with the first, climbs up his pole and sticks his finger into a cell which connects with a cable running to the Lafayette exchange.

"The subscriber wants, let us say, No. 1609 Lafayette. He dials, first, the figures "16." Immediately, without waiting for the call to be completed, a third monkey, connected with the second, slips up along the proper honeycomb and stops with his finger in the hole which controls all the Lafayette numbers between 1,500 and 2,000.

"Now the third and fourth members are dialed—09—and, quick as a flash, the fourth of the herd of educated mechanical monkeys jumps up his stick and makes the final and complete connection. It all takes about eleven seconds.

"All this may sound complicated. It is, actually, 32,000 times as compli-

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cated as it sounds. To watch it in operation is to grow goggle-eyed. To listen to an expert explain it is to wonder why the demand for insane asylums is not doubled."

Ben Woodbury Signed as Stromberg Carlson Sales Star

Rochester, N. Y.—Ben Woodbury, who is one of the best known figures in the Independent telephone industry, has been signed as special sales representative by the Stromberg-Carlson Telephone Mfg. Co. Woodbury, until recently, was connected with the Kellogg Switchboard and Supply Co. in a sales executive capacity. For more than twenty years he has been in close association with the telephone industry. He started when he was launched on the cold, cruel business world as an employe of the Cuyahoga Telephone Co., at Cleveland. This was an enforced first flight for Ben as he was chopping short his scholastic career at Kenyon due to N. S. F. The income from the Cuyahoga job enabled him to complete his college course and after he had finished at Kenyon he went to work at a bench for Kellogg's from which position he arose to that of vice-president and sales manager.

His command of the details of the Independent telephone business, both from the technical and personnel standpoints, made him one of the most popular men in the field. Evidence of his activity and standing is apparent in his status as director of the U. S. Independent Telephone Association and in his lively participation in various state association affairs.

With Stromberg-Carlson Mr. Woodbury will act as special representative in helping telephone companies in the solution of their problems. He plans to make his headquarters in Rochester, but of course, will be visiting telephone companies a good part of the time.

OUR LITERARY DIGEST

Review of Recent publications on the Telephone and Allied Subjects.

Drake's Radio Cyclopedia, Harold P. Manley, Frederick J. Darke & Co., Chicago

Radio fans, here is your big book. In one volume may be found concise definitions of every radio term from A-battery to zerobeat. It covers everything within the radio construction and operating field from hacksaws to heterodynes and from screwdrivers to skin effect. Not only is the work exhaustive from the standpoint of giving information about every detail of radio operation, but the individual articles are clear and as complete as a work of this character will permit. It is not a book to be read like a novel, but is one that for constant reference should be within easy reach of the radio experimenter and constructor and one which will give the ordinary radio fan an understanding of many of the terms which he so often finds puzzling.

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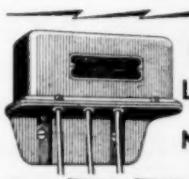

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Western Elec. No. 2C Ball type combine line drops and jacks, per strip of 5 @	7.50
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Kellogg No. 533 type C. B. Steel Hotel Sets (retard coil type), straight line @ $5.75—Harmonic 16-33-50 or 66 cycle @	6.00
Dean or Garford C. B. Steel Hotel Sets (balance coil type), straight line @ $5.25—Harmonic 16-33-50 or 66 cycle @	5.50
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